The Boeing 737-200 in Military Service

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Introducing the 737-200 Multimission Military Transport

The Boeing 737-200 military transport is a derivative of the 737 commercial jetliner. This aircraft, the most technically advanced short-to-medium-range transport available, is built by the same engineering and manufacturing team that produced the medium-range 727, the world's most popular commercial airliner.

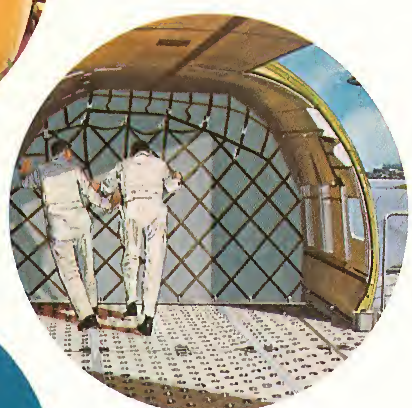
Designed to meet the exacting demands of commercial short-haul, through-stop service, the 737 provides the same outstanding qualities of performance and economy in multimission military service. Particularly attractive to many military operators is the aircraft's ability to take off from short unpaved fields and make repeated en route stops without refueling or use of ground support equipment.

Another significant characteristic is the 737-200's main cabin: It is as wide as the 707 and 727 and wider than the KC-135. This standard-width body, plus the aircraft's large cargo door and convertibility features, permits a wide range of military applications.

The overall design simplicity, major systems grouping, modular subsystems, and convenient engine location result in outstanding *aircraft reliability*, self-sufficiency, and eye-level maintainability.

The 737 fleet has a remarkable record of dispatch reliability: operating at close to 99% (based on ability to depart within 5 minutes of schedule) at an average daily utilization in excess of 6 hours.

In addition to United States Federal Aviation Administration (FAA) certification, the 737 is certified by the Civil Aviation Authority (CAA) of Great Britain and the regulatory agencies of 18 other countries. The 737 has established an outstanding safety record in 10 years of international service.



Design Advantages

The 737-200 is the most spacious twinjet in production. The aircraft's main cabin width is identical to that of the larger 707 and 727; thus the 737 accommodates the same military and commercial pallets as these aircraft. Space is provided on the main deck for 4,636 cubic feet (131.3 cubic meters) of cargo plus another 875 cubic feet (24.8 cubic meters) in the lower holds.

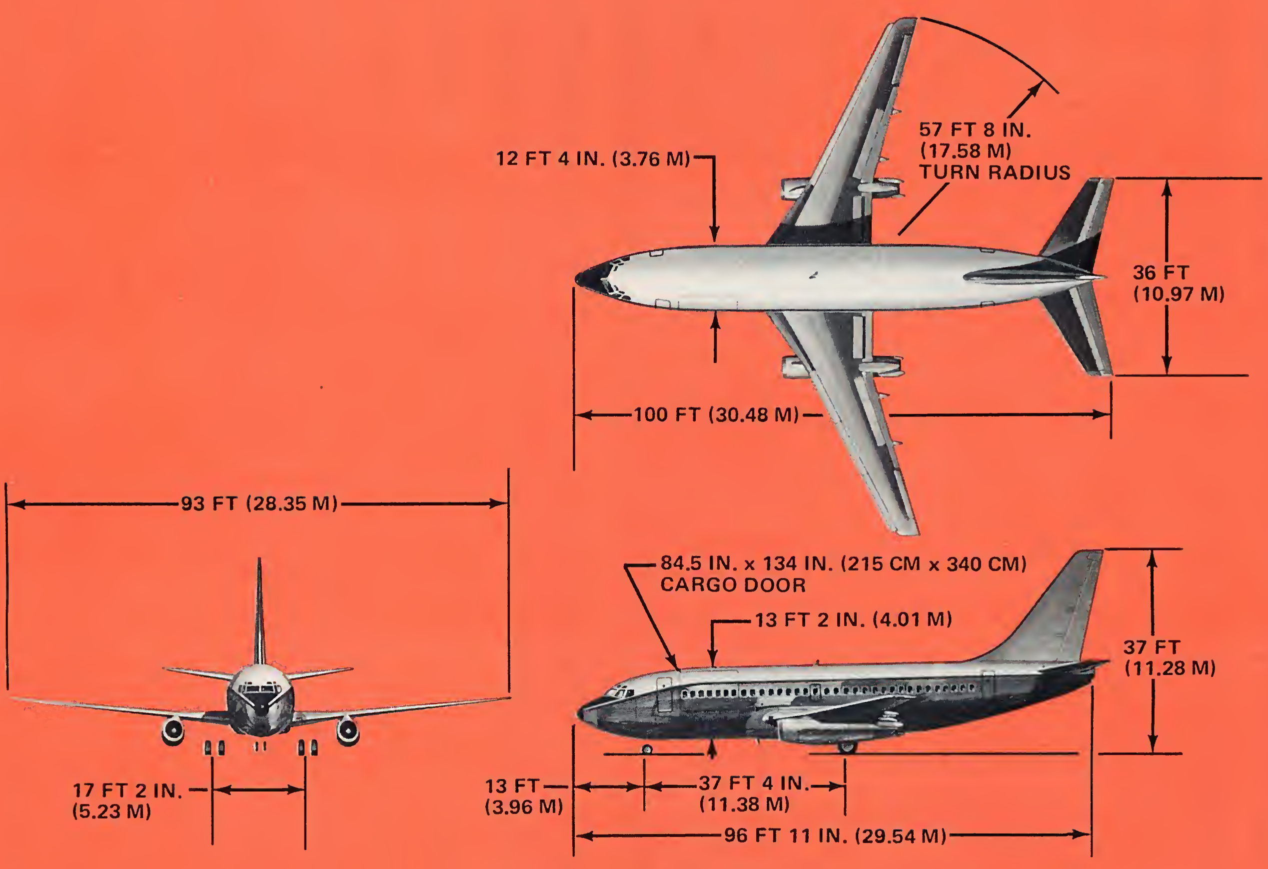
An onboard APU, a self-contained aft airstair, an optional self-contained cargo loader, and a forward airstair enable the aircraft to be self-sufficient while on the ground.

Engines located below the wing provide significant advantages. The effect of the under-wing engine location on aircraft center-of-gravity limitations results in the 737-200's tolerance to large variations in load distribution without the use of ballast. Use of underwing engines enables full utilization of available fuselage space.

The wing-mounted engines are well away from debris that may be thrown up by nose and main landing gears. Their position also permits better door utilization and emergency-exit distribution, including an 84.5- by 134-inch (215- by 340-centimeter) cargo door for loading the same containers and pallets carried by 707/727-size aircraft.

The 737 is designed for extended structural life in the more severe fatigue environment of multiple-stop service. The structure is a "fail safe" design. If a crack should develop in a critical area, alternate structural load paths are available to carry the full load.

Outside Dimensions



Major 737 design objectives to optimize reliability and maintenance costs were:

- Minimum number of components
- Component accessibility
- Use of proven components, combined with the latest technological improvements
- Eye-level placement of inspection and maintenance access points
- Modular component packaging
- Grouping of components and modules by system
- Self-test capability

Reported data from current operators indicate that attainment of these objectives has reduced the maintenance cost of the 737 below that predicted.

All engine maintenance—as well as nearly all other service maintenance—is done from ground level. An engine change can be accomplished in 50 minutes without the use of ground stands.

The basic usable fuel capacity of the 737-200 is 5,164 U.S. gallons (19,548 liters) contained in three integral wing tanks.

The basic fuel capacity can be augmented by installation of tanks in the lower baggage compartments. Option 1, an 810-gallon (3,066-liter) fuel cell in the aft cargo compartment, increases the usable fuel capacity to 5,974 U.S. gallons (22,614 liters).

Option 2 (not illustrated) consists of a 1,070-U.S.-gallon (4,050-liter) tank installed in the aft baggage compartment and a 650-U.S.-gallon (2,461-liter) tank in the forward baggage compartment, increasing total aircraft tankage to 6,884 U.S. gallons (26,059 liters).

Additional optional baggage compartment fuel tank configurations increase the total available fuel capacity to 7,164 U.S. gallons (27,119 liters).

Principal Characteristics

Transport and Patrol Configurations

	Standard-Gross-Weight-Structure	High-Gross-Weight-Structure Option
Maximum Taxi Weight—Lb (Kg)	117,500 (53,297)	128,600 (58,332)
Maximum Brake-Release Weight—Lb (Kg)	117,000 (53,070)	128,100 (58,105)
Maximum Landing Weight—Lb (Kg)	105,000 (47,627)	107,000 (48,534)
Maximum Zero-Fuel Weight—Lb (Kg)	95,000 (43,091)	99,000 (44,906)
Operating Empty Weight	*	*
Total Fuel Capacity—U.S. Gal (Liters)		
Basic (Wing Fuel	5,164 (19,548)	
Option 1**	5,974 (22,614)	
Option 2**	6,884 (26,059)	
Fuselage Compartment Volume—Cu Ft (Cu M)		
Main Deck	4,636 (131.3)	
Lower Deck (Baggage Compartments)	875 (24.8)	
Lower Deck (With Option 1 Fuel)	640 (18.1)	
Lower Deck (With Option 2 Fuel)	450 (12.7)	
Engines		
Two Pratt & Whitney (JT8D-17R)		
Sea-Level Static Thrust at 77°F—Lb (Kg)	16,400 (7,439)	
With APR Activated*** —Lb (Kg)	17,400 (7,893)	
Maximum Operating Airspeed (KEAS)	350	
Maximum Operating Speed	Mach 0.84	

* Operating empty weight varies with mission equipment configuration and fuel tank options. Typical OEWs are shown on performance curves for each example mission.

** Basic wing fuel augmented by tank(s) added in lower baggage compartment(s).

*** Automatic Performance Reserve (APR) provides an automatic thrust increase from the operable engine in the unlikely event of engine failure during takeoff. No pilot adjustment of thrust levers is required.

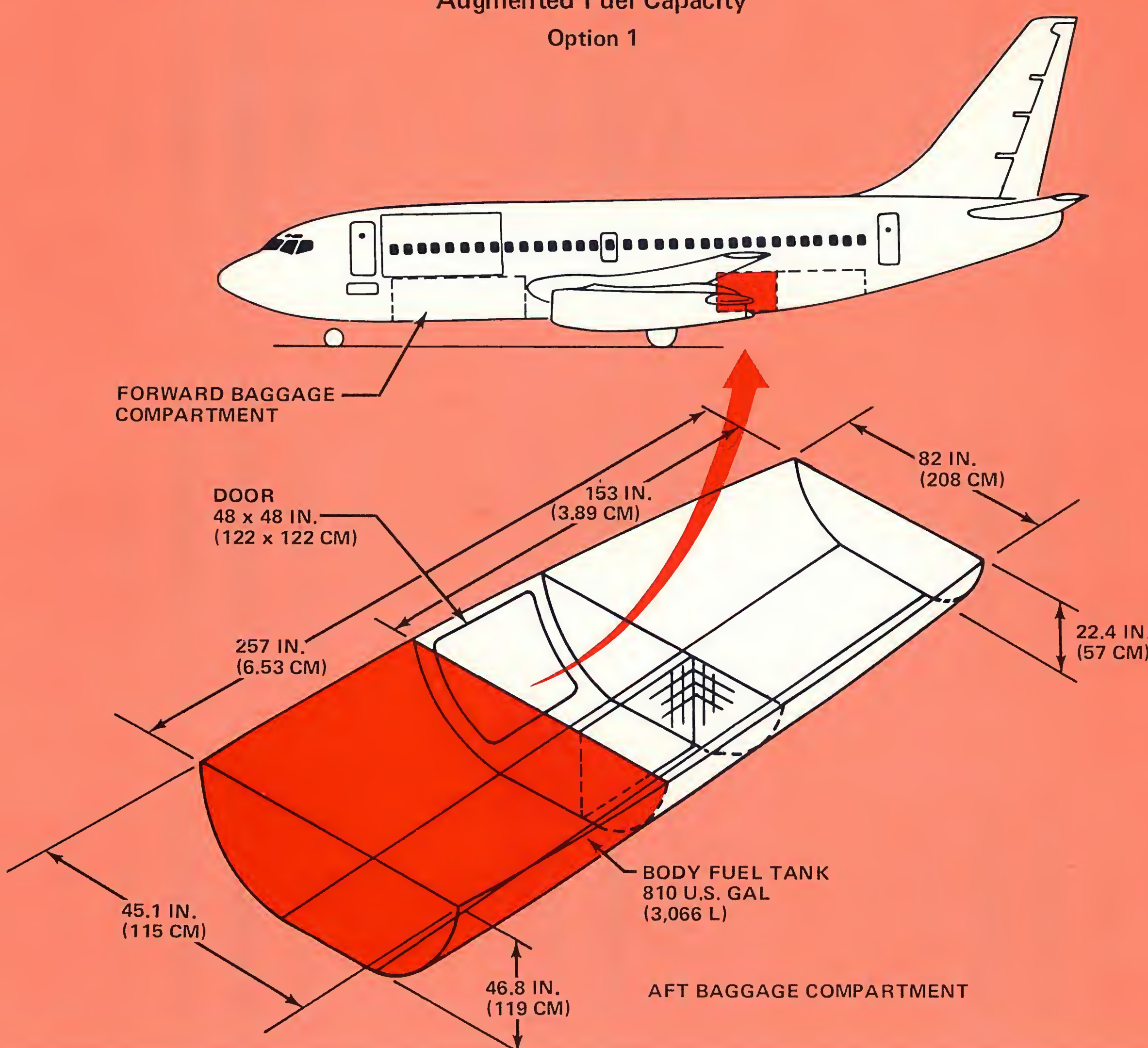
Operational Features

Fully loaded, the standard-gross-weight structure 737-200 carried 115 troops 1,720 nautical miles (3,185 kilometers) or 35,740 pounds (16,211 kilograms) of cargo 1,020 nautical miles (1,889 kilometers). In the executive transport configuration, it carries a party of up to 33 military and government executives and staff over 2,500 nautical miles (4,630 kilometers) with basic fuel—farther with optional fuel—making intercontinental missions routine. The specific range performance for each basic mission is contained in the MISSION CONFIGURATIONS AND PERFORMANCE section. The high-gross-weight structure option offers increased range and/or payload for certain missions, as illustrated by the troop transport and cargo transport payload-range curves.

Human factors and simulator performance studies were used in optimizing the control cabin design for a minimum two-man crew workload. Self-monitoring subsystems are employed with automation increased to a high degree. Every control is either accessible to or duplicated for both pilots; thus, all flight operations may be conducted by one pilot from either seat. Ten windows in the cockpit allow the crew an excellent field of vision. Advanced high-lift devices on the wing, combined with automatic braking and highly effective thrust reversers, give the 737-200 outstanding short-field performance. At nominal gross weights, daily operations from fields 4,000 to 5,000 feet (1,219 to 1,524 meters) long are routine.

Augmented Fuel Capacity

Option 1



Standard equipment in the 737-200 meets the requirements for Category II manual and automatic approach: 1,200-foot (366-meter) runway visual range and 100-foot (30.5-meter) ceiling. The high-lift system provides a low approach speed combined with excellent approach stability. The low approach speed results in reduced runway landing length requirements. Increased time is available for the pilot to acquire visual orientation and make flightpath corrections during transition from approach to touchdown. The approach stability permits smooth flight with minimum throttle adjustment and attitude change, even though flap position and airspeed changes may be required.

The high-performance thrust reversers are among the most effective in use. The automatic braking system provides immediate, smooth brake application. The system is actuated by wheel spinup and automatically decelerates the aircraft at a predetermined rate. The aircraft's improved antiskid system produces effective braking on wet and icy runways and provides significantly smoother braking than other antiskid systems.

The 737-200 is capable of operation from unpaved runways. This capability applies to operation on any unpaved field that has adequate soil bearing strength to support the aircraft. To provide even greater operational flexibility, a low-pressure-tire option is offered for use on runways where flotation characteristics are critical.

Boeing delivered 19 twinjet 737-200 aircraft (USAF designated T-43A) in 1973 and 1974 to the U.S. Air Force for airborne training of navigators. These aircraft replaced 77 piston-engine T-29s used for training since 1952.

Tanker Configuration

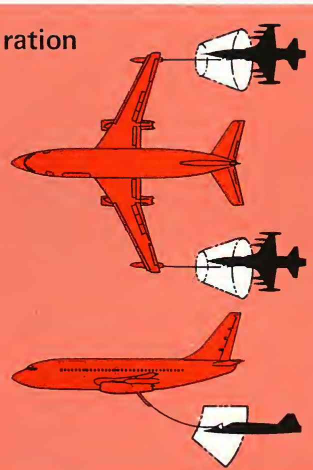
Fitted with appropriate refueling equipment, the 737-200 becomes an effective aerial refueling tanker, increasing the range and weapon-carrying capability of either probe or receptacle-equipped fighters.

Principal modifications to the basic aircraft include additional fuel tanks and installation of wing-tip hose/drogue or fuselage-mounted boom refueling equipment with the required control systems.

Multimission convertibility features enable the 737-200 to fill many additional military and government mission requirements while retaining full basic tanker capability.

Formating diagrams of typical fighter refueling hookups are shown below. A more detailed description of the required refueling equipment is presented in the following section, MISSION CONFIGURATIONS AND PERFORMANCE. Examples of increased fighter force productivity through application of aerial refueling tactics are shown in the MISSION ANALYSIS section.

Hose/Drogue Configuration
F-5 Typical Receiver



Flying-Boom Configuration
F-16 Typical Receiver

Principal Characteristics
Tanker Configuration

	Hose/Drogue Configuration		Boom Configuration	
Maximum Taxi Weight*				
2.50 Load Factor	117,500 Lb	53,297 Kg	117,500 Lb	53,297 Kg
2.25 Load Factor	130,280 Lb	59,094 Kg	130,540 Lb	59,212 Kg
Maximum Landing Weight	105,000 Lb	47,627 Kg	105,000 Lb	47,627 Kg
Maximum Zero-Fuel Weight				
2.50 Load Factor	96,500 Lb	43,772 Kg	96,500 Lb	43,772 Kg
2.25 Load Factor	106,500 Lb (Est)	48,308 Kg (Est)	106,500 Lb (Est)	48,308 Kg (Est)
Maneuver Load Factor*				
Standard Operation	2.50		2.50	
Critical Mission Operation	2.25		2.25	
Operating Empty Weight	67,400 Lb	30,572 Kg	68,570 Lb	31,103 Kg
Fuel Capacity				
Basic Wing	5,164 U.S. Gal	19,548 L	5,164 U.S. Gal	19,548 L
Lower Deck (Baggage Compartment)	1,070 U.S. Gal	4,050 L	930 U.S. Gal	3,520 L
Upper Deck	3,440 U.S. Gal	13,022 L	3,440 U.S. Gal	13,022 L
	9,674 U.S. Gal	36,620 L	9,534 U.S. Gal	36,090 L
Cargo Volume				
Main Deck	4,636 Cu Ft	131 Cu M	4,636 Cu Ft	131 Cu M
Lower Deck (Baggage Compartment)	875 Cu Ft	25 Cu M	875 Cu Ft	25 Cu M
Lower Deck (With Fuel Tank(s) Installed)	595 Cu Ft	17 Cu M	375 Cu Ft	11 Cu M
Engines				
Two Pratt & Whitney (JT8D-17R)				
Sea-Level Static Thrust at 77°F (25°C)	16,400 Lb	7,439 Kg	16,400 Lb	7,439 Kg
With APR Activated**	17,400 Lb	7,893 Kg	17,400 Lb	7,893 Kg

* Maximum taxi weight is a structural weight limit based on specific ground maneuver and flight maneuver load factor criteria. The maximum weights shown for 2.50g flight load factor are the weight limits for normal operation. For critical missions, the maximum taxi weight may be increased to the weight indicated by relaxing the load factor criteria, permitting increased fuel transfer.

Sustained operations at higher gross weights with reduced load factor can result in a reduction in structural fatigue life. In tanker service, this effect is minimized because fuel burned and transferred to receivers reduces the gross weight to normal levels early in the mission. This, combined with the high design structural life of the 737-200 airframe, allows selective operation at reduced load factor without serious degradation of airframe life.

**Automatic Performance Reserve (APR) provides an automatic thrust increase from the operable engine in the event of engine failure during takeoff. No pilot adjustment of thrust levers is required.

®

Mission Configurations and Performance

®

Mission Configurations and Performance

- Executive Transport
- Troop Transport
- Cargo Transport
- Maritime Patrol
- Civil Disaster Relief

Mission Versatility

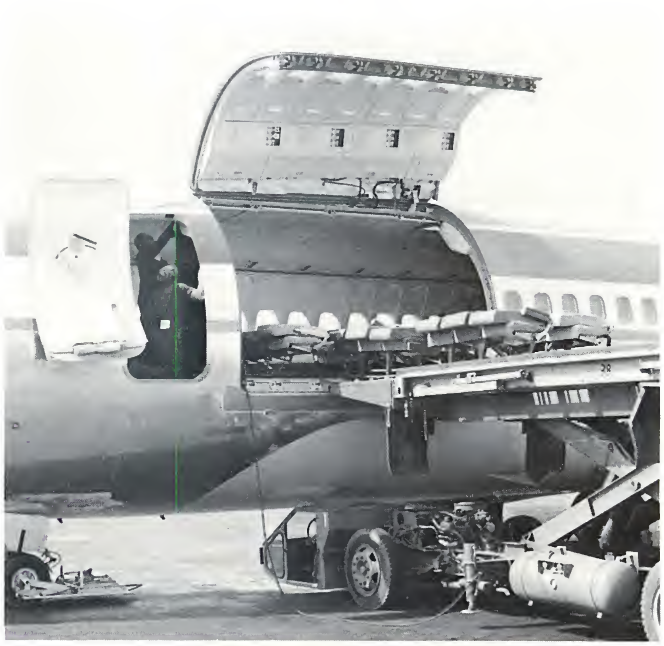
The 737-200 is a jet-age military transport; its convertibility features are designed for multi-mission service. Several basic missions are illustrated in this section. Variations of these basic missions and other potential missions are virtually unlimited.

Convertibility

The key to the practical utility of the 737-200 is its convertibility.

When converting from a troop configuration to other configurations, seat track covers are removed and stowed in the back pocket of adjacent seats. Then, the desired number of seats are unlocked, using no special tools, and removed as individual units from the floor. (Troop seats are available having folding legs for compact storage in a lower cargo compartment or on a cargo pallet.)

Extra fuel tanks, high-density and outsized cargo, executive transport furnishings, special electronic equipment, passenger seats, and other hardware can be palletized for shipment or on-board use. No special tools are required to attach side guides, roller trays, and pallet locks to the seat tracks when converting to a palletized configuration.



Executive Transport

Executive Transport

Today's world often demands personal dialogue between heads of state on very short notice. Boeing jets provide transportation between major world capitals for the President of the United States and heads of state of many other nations.

The 737-200 has proven its ability to meet the performance, reliability, and operationally ready rates required in this service.

In the executive transport configuration, the 737 carries the head of state or chief executive and up to 32 staff personnel and guests a nonstop distance of over 2,500 nautical miles.

For multimission convertibility, field installation of an executive interior furnishings kit is practical within a few hours' notice.

When the aircraft is dedicated to executive travel, more permanent furnishings are installed, resulting in a "fixed" interior configuration.

A wide variety of custom interior arrangements are available to meet any required level of convenience, comfort, and capability.

Galley Installations **Fixed and Convertible**

Office/Lounge Area

Fixed

Lavatory

Fixed

Fixed Interior With Private Stateroom

The wide fuselage cross section of the 737-200 permits installation of a completely enclosed private stateroom and adjoining lavatory, while retaining a fore-and-aft passageway for movement of staff and attendants throughout the remainder of the aircraft.

The accompanying floor plan and photographs illustrate a typical fixed interior arrangement that can be installed in the 737-200.

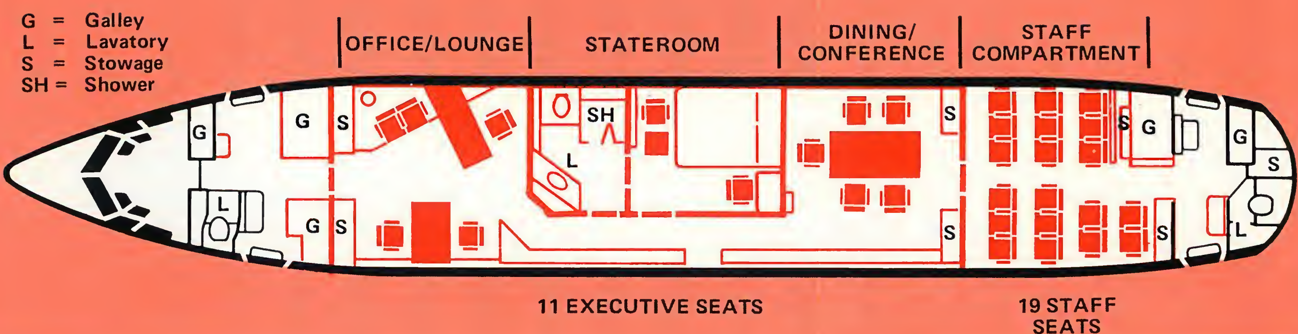
Each executive interior is customized using stock components to meet the requirements of individual governments.

Comfortable Working Environment

The working environment within the 737-200 executive transport is the most comfortable available. Conditioned air is uniformly discharged throughout the length of the cabin from the draft-free overhead distribution system. Air is exhausted near the floor through return-air openings in the compartment sidewalls. Individually adjustable air outlets supply air directly to each work area.

An electronically controlled cabin pressure control system operates automatically. Cruise altitude and destination altitude are selected before takeoff; thereafter, the system controls cabin conditions without attention. Sea-level cabin pressure can be maintained to 18,500 feet altitude; at 35,000 feet altitude, the cabin pressure is equivalent to 8,000 feet altitude.

Fixed Interior Arrangement
Example




Stateroom Passageway — Fixed

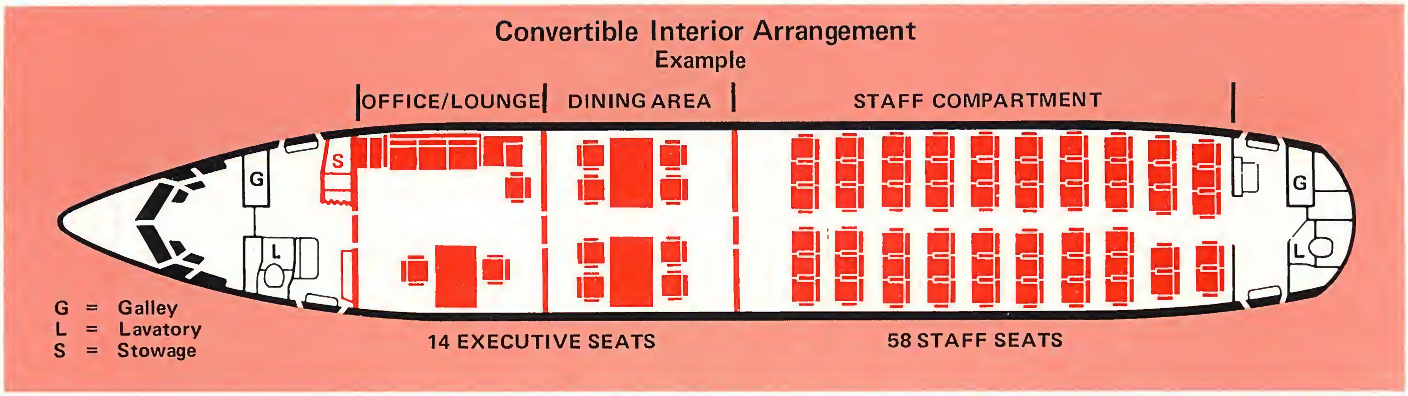

Stateroom — Fixed

Convertible Interior

An easily installed interior executive furnishings kit is offered for applications requiring rapid conversion from any mission configuration to the executive configuration.

Bulkheads and all furnishings are seat-track mounted and can be installed or removed without special tools.

The accompanying floor plan and photographs describe a typical convertible interior arrangement. Many variations of this basic arrangement are possible to meet individual requirements.



Office/Lounge Area

Convertible

Office/Lounge Area

Convertible

Dining Area

Convertible

Executive Transport Payload Range

The 737-200 offers economical executive jet travel between major capital cities of the world.

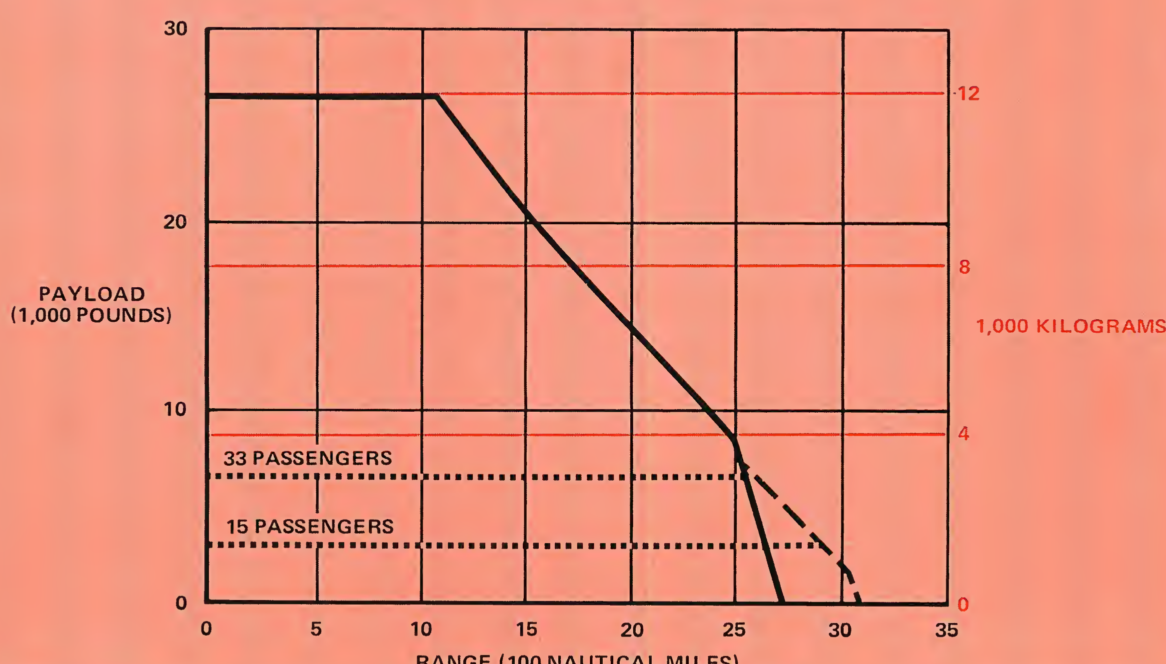
In the executive transport configuration, the 737-200 carries a total of 33 passengers a nonstop distance of 2,550 nautical miles using Option 1 fuel capacity. Fifteen passengers are carried 2,900 nautical miles using Option 2 fuel capacity.

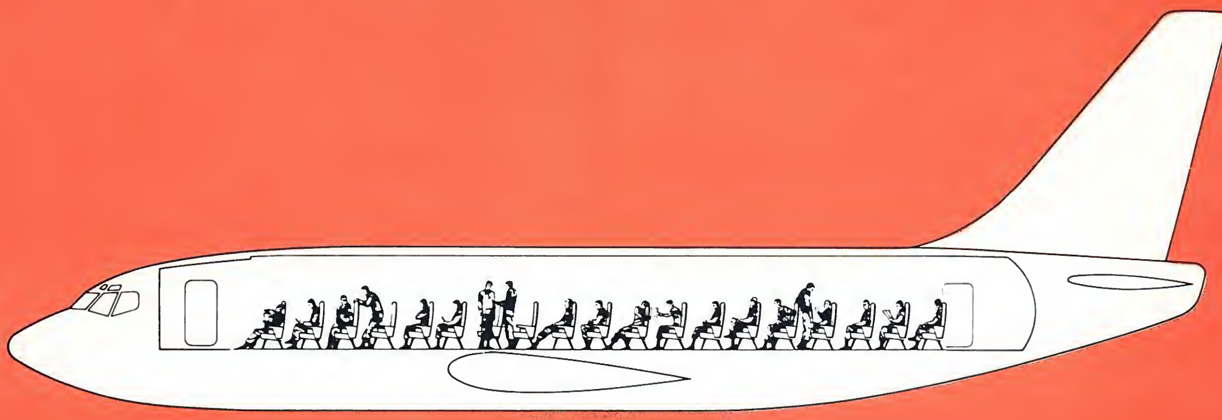
737-200 Payload Range

Executive Configuration

- STANDARD DAY
- ENGINES: JT8D-17R
- MIL-C-5011A RULES
- MAX RAMP WT: 117,500 LB (53,297 KG)
- PASSENGER WT: 200 LB (90.7 KG)

FUEL CAPACITY	OPERATING EMPTY WEIGHT
(solid line) 5,974 U.S. GAL (22,614 L) (OPTION 1)	69,940 LB (31,724 KG)
(dashed line) 6,884 U.S. GAL (26,059 L) (OPTION 2)	71,000 LB (32,205 KG)





Troop Transport

Troop Transport

Self-sufficiency, short takeoff and landing, and a capability to operate from remote airstrips are desirable characteristics of aircraft for troop transport missions. The 737-200 has the capability to satisfy these needs.

Troops can be unloaded quickly through the two standard-size doors . . . and it can be done without ground support equipment. The onboard auxiliary power unit supplies electrical power, air conditioning, and engine start air on the ground.

An optional self-contained cargo loader, powered from the APU, quickly loads and unloads palletized troop support equipment, cargo, and vehicles. When equipped with the optional gravel-runway kit, the aircraft is certified to operate from unpaved airstrips. High-flotation tires are also available for operation on airstrips of marginal strength.

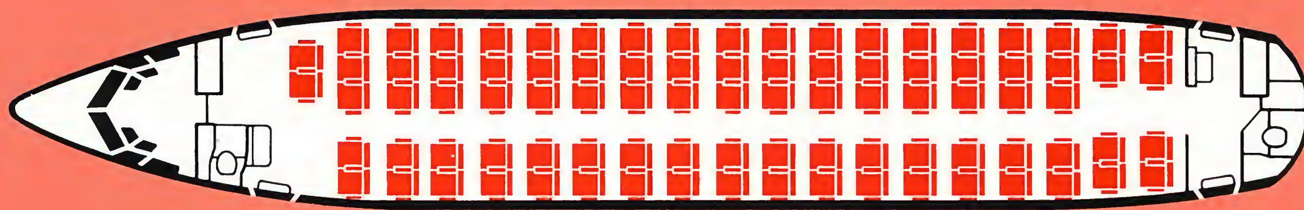
Large Capacity for Troops

All-troop interiors may be configured with four-, five-, or six-abreast seating. Shown here are the 90-troop, five-abreast seating arrangement at 36-inch (91-centimeter) pitch, the higher density 115-troop, six-abreast seating arrangement at 34-inch (86-centimeter) pitch, and a mixed passenger-cargo configuration. Seating arrangements with densities as high as 129 passengers are available with reduced seat pitch.

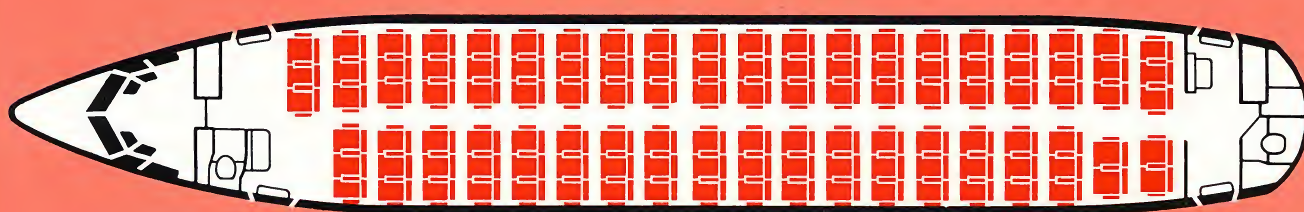
The 737-200 door arrangement provides excellent access whether in all-troop or in a combination cargo-troop arrangement. Two additional cabin emergency exits are located over the wing.

The basic aircraft has a lavatory and a galley at each end. Other interior arrangements are available as options.

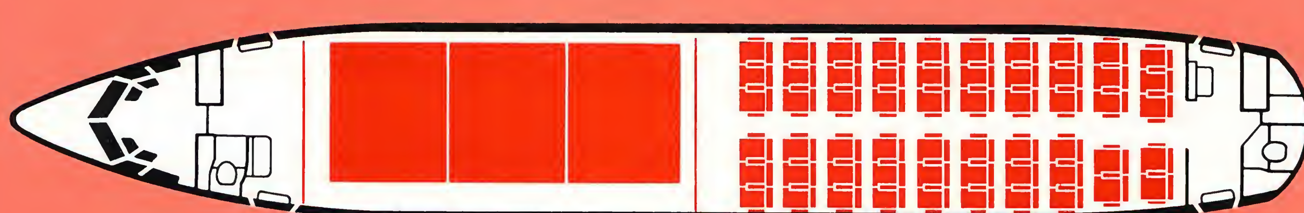
90-Troop Seating Configuration



115-Troop Seating Configuration



3 Cargo Pallets Plus 58-Troop Seating Configuration



Operation From Remote Airstrips

A basic 737-200 design objective—fly longer distances from short airfields—makes this aircraft ideal for transporting troops into combat staging areas. It can approach the world's smaller airstrips at the lowest speed of any similar jet (about 117 knots at typical landing weights) and, after landing, come to a rapid stop. The automatic braking system, high-performance thrust reversers, and improved antiskid system give the 737-200 an unmatched stopping capability.

The 737-200 can be fitted with an FAA-approved gravel runway kit (optional). This kit—consisting of nose- and main-gear deflectors, engine vortex dissipators, a retractable anticollision light, and abrasion protection—permits operation from unpaved airfields previously inaccessible to jet aircraft.

Additional information concerning runway strength requirements is contained in a following subsection; GENERAL PERFORMANCE CHARACTERISTICS. The gravel-runway equipment kit is fully described in the DESIGN FEATURES section.

Many Through-Stops

The 737-200 can make repeated through-stops without refueling or servicing. For instance, two 130-nautical-mile trips can be flown into a staging area with 115 troops, returning from each flight with a full load of patients (as many as 48 on litters) that may need immediate medical attention. In addition, 875 cubic feet (24.8 cubic meters) of space is available in the lower holds for carrying troop medical supplies, field equipment, litters, or troop seats.

Self-Contained Airstair

An electrically powered airstair is built into the aft entry door, thus eliminating the need for ground stairways. The airstair is powered from the aircraft and requires no ground support electrical power. A similarly powered forward airstair is available as an option.

Manual stairway extension can be accomplished from either inside or outside the aircraft. Manual retraction is provided from the inside only.

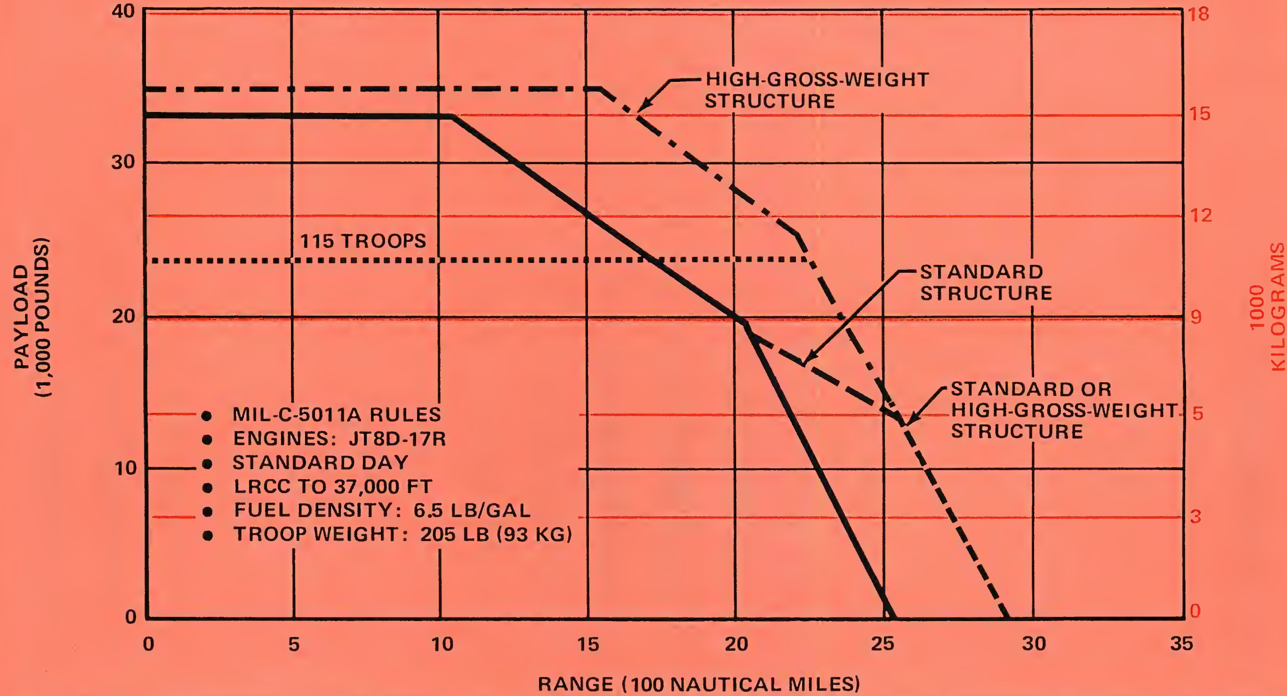
The forward entry and service doors are of the inward/outward-opening plug type. Two 20- by 38-inch (51- by 97-centimeter) overwing exits are centrally positioned in the cabin.

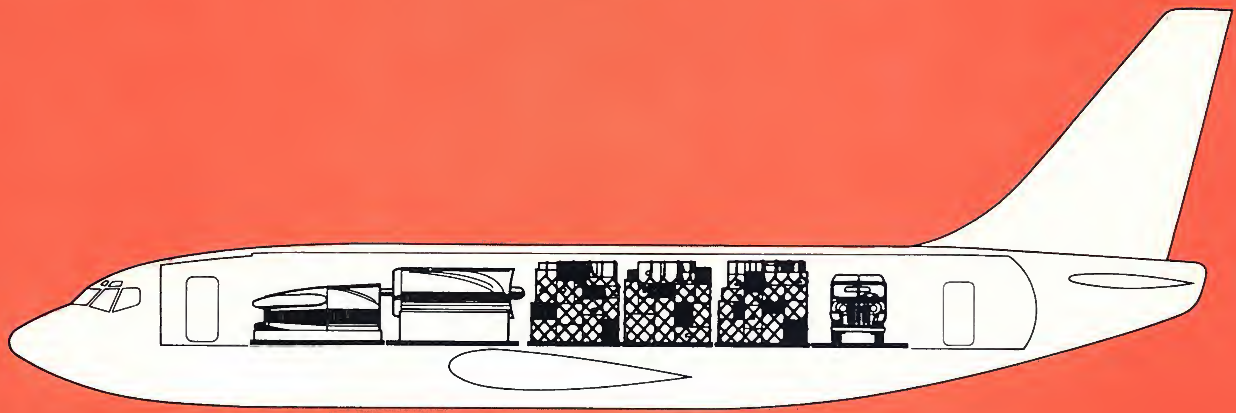
Troop Transport Payload Range

The payload-range curves below illustrate the 737-200 nonstop troop-carrying capability versus range. With standard structure and fuel capacity, the airplane can carry 115 troops 1,720 nautical miles; with optional high-gross-weight structure and fuel capacity, the range is extended to 2,260 nautical miles.

Troop Transport Payload Range

REFERENCE	STRUCTURE	MAXIMUM RAMP WEIGHT LB (KG)	FUEL CAPACITY U.S. GAL (LITERS)	OPERATING EMPTY WEIGHT LB (KG)
———————	STANDARD	117,500 (53,297)	5,164 (19,548)	62,660 (28,422)
- - - - - - -	STANDARD	117,500 (53,297)	5,974 (22,614)	63,800 (28,939)
— · — · —	HIGH GROSS WEIGHT	128,600 (58,332)	5,974 (22,614)	64,300 (29,166)



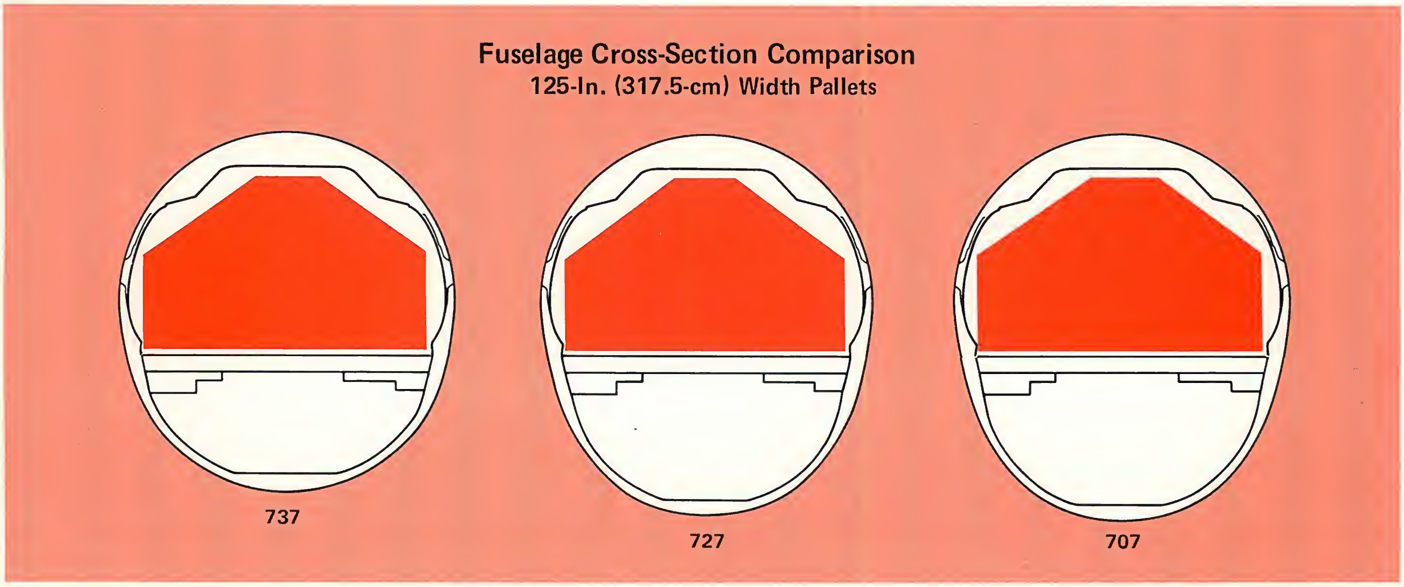


Cargo Transport

Cargo Transport

With a cabin width identical to that of the large 707 and 727 jets, the 737-200 can accommodate pallets and containers interchangeably with these and other large aircraft.

The main-deck floor strength permits loading of the higher density cargo normally associated with military operations. An 8,000-pound (3,628-kilogram) pallet load can be positioned anywhere in the aircraft. Floor strength permits loading of cargo weighing up to 400 pounds per square foot (1,953 kilograms per square meter). Wheeled-vehicle loads up to 2,500 pounds (1,134 kilograms) per wheel are permissible with shoring.



Loading

The cargo door is the same width (134 inches, or 340 centimeters) as that of the 707 and 727 and accepts standard 463L pallets. Jeeps and similar vehicles can be loaded without difficulty. The cargo door and aft passenger door can be used for simultaneous loading of troops and cargo.

The cargo door opens to either of two positions: For normal palletized cargo, it is opened to a canopy position with the door forming a protective rain cover. For crane-lifted cargo, the door is fully opened to provide vertical access to the exposed cargo floor area.

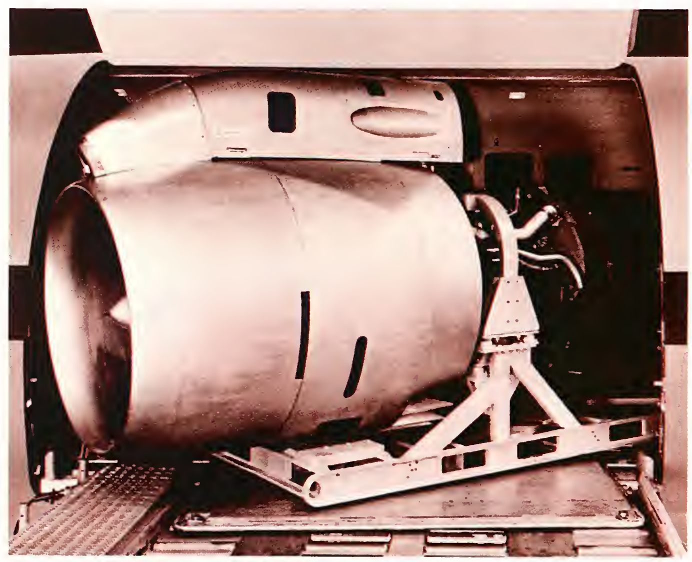
Size limits—height, width, and length—for rectangular cargo are shown in the loadability table on the following page.

Bulk Cargo Loadability
Maximum Package Size

Height (In.)	Width (In.)												
	5	15	25	35	45	55	65	75	85	95	105	115	120
	Length (In.)												
72-81	304	254	218	192	169								
68-72	339	279	237	206	184	161							
64-68	465	350	296	247	218	192	166						
60-64	639	481	387	315	267	233	207	185	164	146			
56-60	663	616	457	366	303	261	228	203	183	163	145	133	
51-56	663	651	491	386	320	272	237	211	189	169	151	136	
2-51	663	661	537	417	341	287	251	222	197	177	161	147	141

All-Cargo Interior

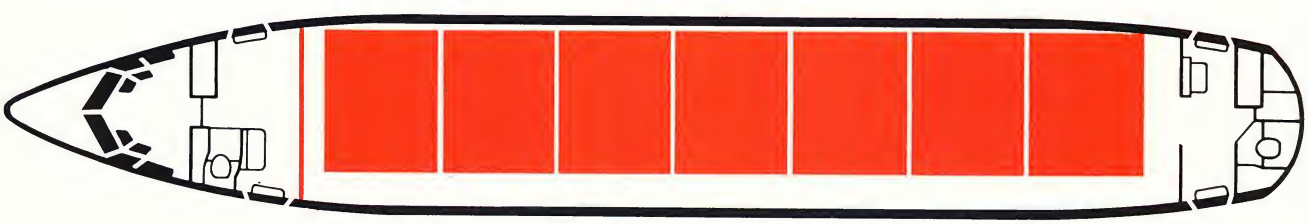
In the all-cargo interior arrangement, the main cabin has a floor width of 128.3 inches (325.9 centimeters), a length of 68.5 feet (20.9 meters), and a maximum height of 84.5 inches (214.6 centimeters), for a total volume of 4,636 cubic feet (131.3 cubic meters).



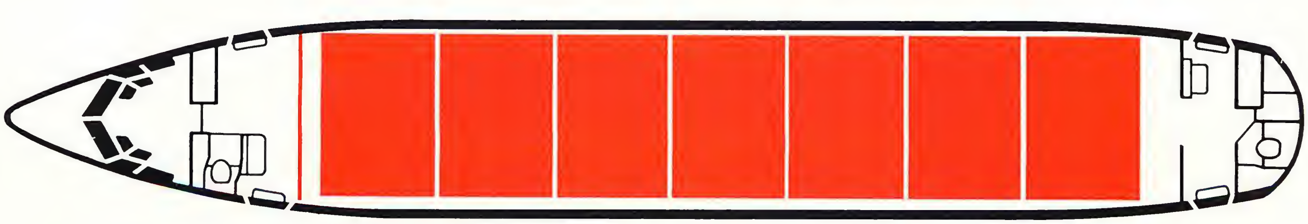
The large cargo door and wide-body cross section permit loading of seven military 463L pallets, 88 by 108 inches (224 by 274 centimeters); seven commercial pallets, 88 by 108 inches or 88 by 125 inches (224 by 318 centimeters); or a combination of these pallets. Total volume of the seven commercial 88- by 125-inch pallets is 2,870 cubic feet (81.3 cubic meters).

With the 108-inch-wide pallets installed, an aisle on the left side of the aircraft permits in-flight inspection of cargo. The 125-inch pallet requires the full cabin width.

Seven Military or Commercial Pallets Configuration



Seven Commercial Pallets Configuration



Combination Cargo-Troop Interior

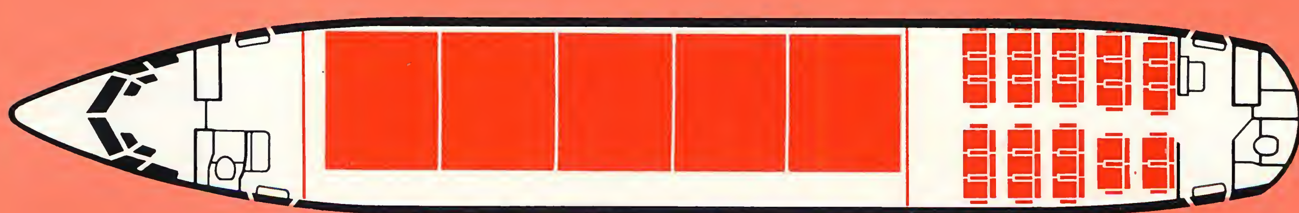
Cargo conversion kits allow a capability for mixed troop-cargo and all-cargo arrangements. These kits include extra fire extinguishers, a cargo-door safety net with stowage bag, sidewall kick plates, and a cargo/troop-compartment bulkhead with door. This bulkhead is used in cargo-troop arrangements to separate the cargo and troop areas.

Pallets and seats may be installed in mixed arrangements. Options of various numbers of cargo pallets and the corresponding number of troop seats are available. The two-pallet, 76-troop and the five-pallet, 28-troop, six-abreast seating interiors are shown.

Cargo systems include pallet tiedowns designed for a 3g forward load and a barrier net that restrains the entire load to 9g forward. Other hardware is available to allow mixing 3g and 9g pallets in the same load. Virtually any operating requirement can be met.

2 Pallets and 76 Troops Configuration

5 Pallets and 28 Troops Configuration



Cargo-Handling Hardware

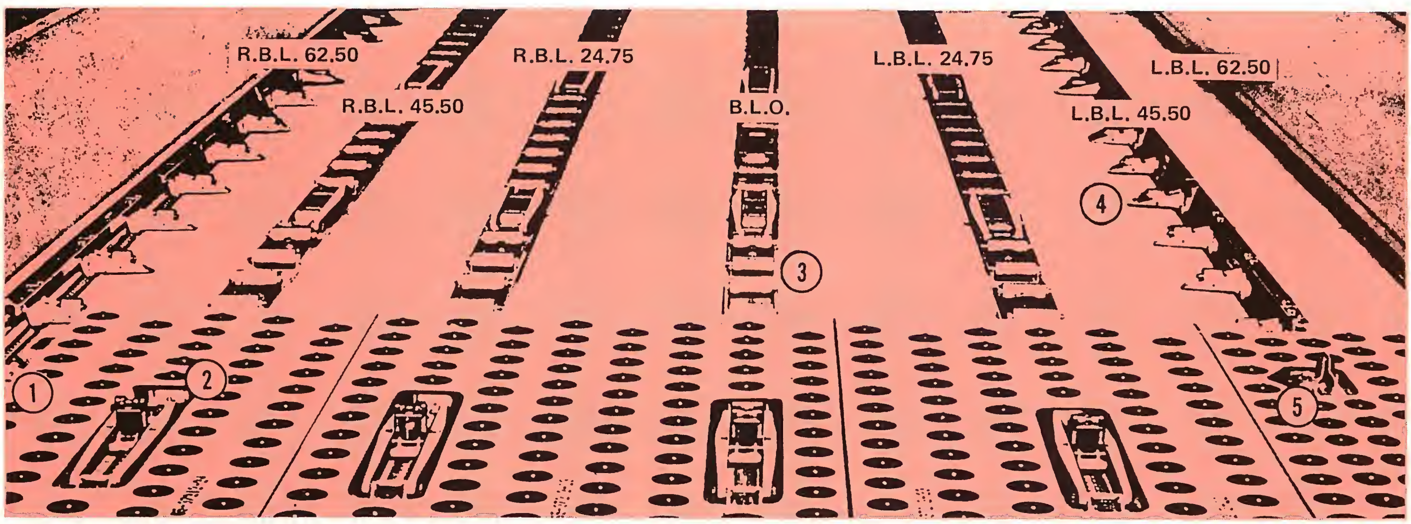
A three-piece threshold roller assembly at the cargo doorsill provides a continuous roller surface over the beveled lower sill between the cargo loader bed and the ball transfer panels.

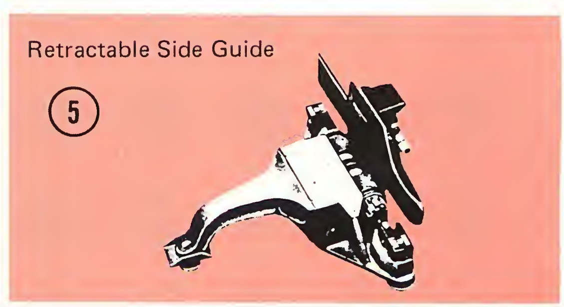
The ball transfer panels adjacent to the cargo door offer initial omnidirectional movement of pallets into the aircraft. From there, pallets are moved longitudinally within the aircraft on seat-track-mounted roller trays to their final lock-down position.

No special tools are required to attach side guides, restraint fittings, pallet rollers, or locks. These cargo-handling fittings are attached to seat tracks with shear pins and vertical restraint studs similar to seat attachment fittings. Guides (1) opposite the cargo door have ball transfer units instead of rollers for consistency with the ball transfer panels. All side guides accept snap-in tie-down fittings for straps to restrain bulk cargo. In flight, the guides are used to prevent lateral movement.

Pallets are restrained fore, aft, and vertically by pallet locks. These locks (2) are installed in the existing seat tracks and transfer loads directly to the floor structure. Like other cargo fittings, the pallet locks and rollers are made of steel and high-strength aluminum alloy. The rollers (3) permit longitudinal movement of the pallets within the airplane and are assembled in easily installed roller trays indexed to the seat tracks.

The side guides (4) guide cargo movement with the cabin. Guides in the ball mat area (5) retract during loading and unloading of cargo.





Pressurized Lower Hold

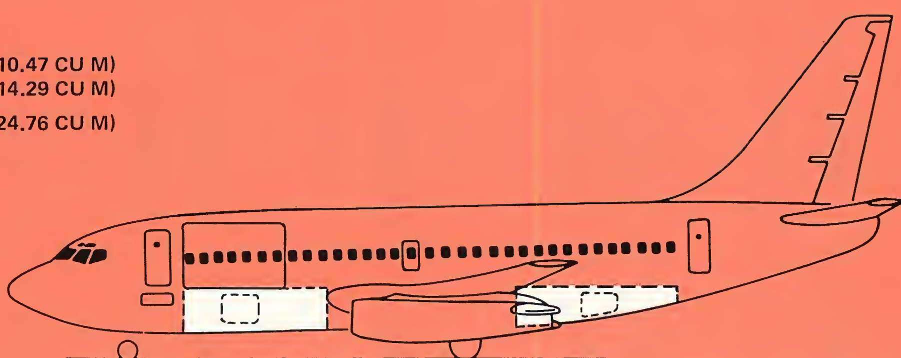
The pressurized lower-hold cargo compartments of the aircraft have a combined volume of 875 cubic feet (24.8 cubic meters)*. The cargo compartment floor-to-ground heights vary from 41.5 to 51.5 inches (105 to 131 centimeters) for the forward compartment and 45.2 to 61.5 inches (115 to 156 centimeters) for the aft compartment, depending upon aircraft loading.

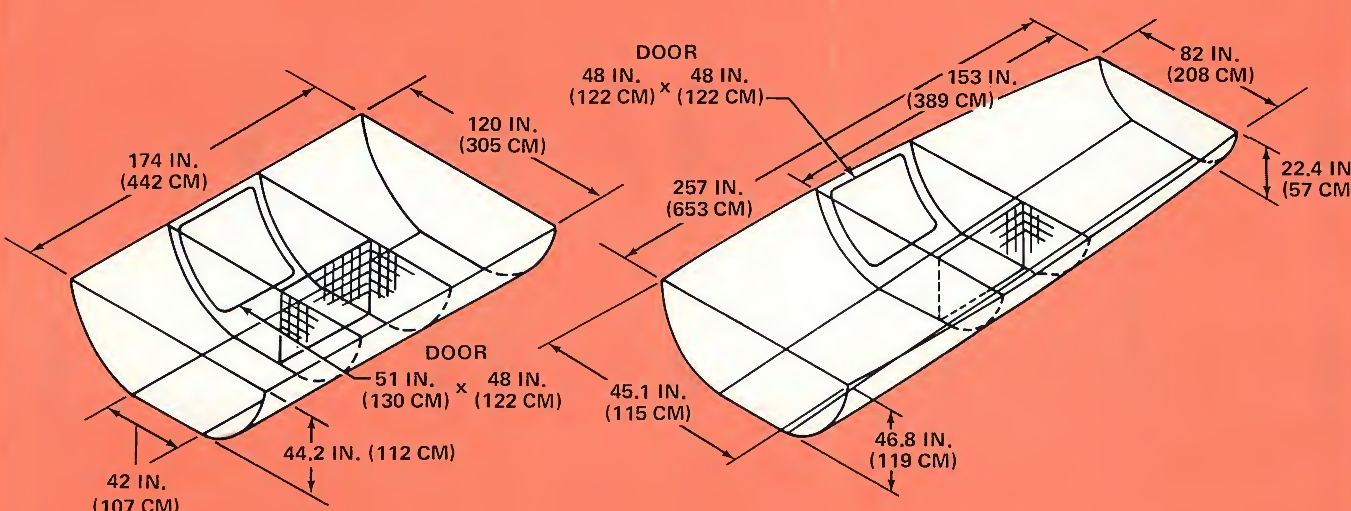
Access doors are inward-upward opening with effective heights as shown. Both doors are equipped with safety lanyards to protect personnel against inadvertent closure.

*Volume of lower cargo holds is reduced when optional body fuel tanks are installed. Refer to the table of PRINCIPAL CHARACTERISTICS in the INTRODUCTION.

Lower Cargo Holds

FORWARD	370 CU FT (10.47 CU M)
AFT	505 CU FT (14.29 CU M)
TOTAL	875 CU FT (24.76 CU M)





FORWARD

AFT

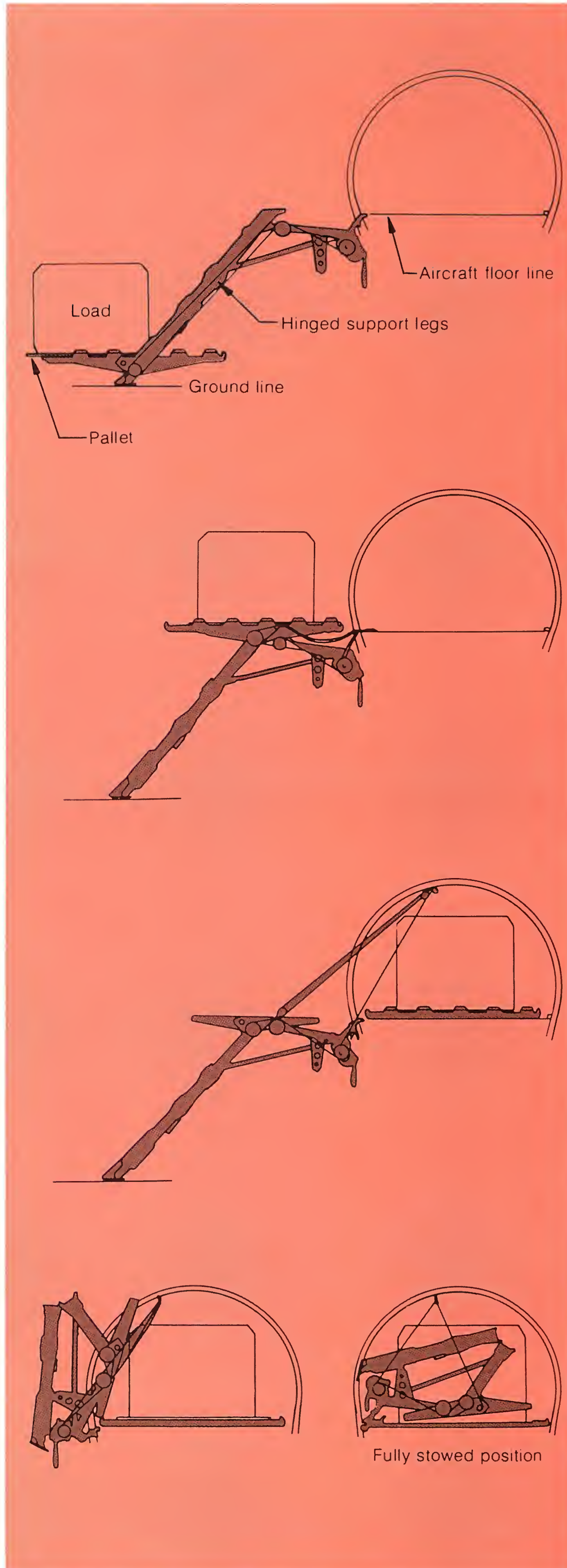
Self-Sufficiency

An onboard auxiliary power unit, aft airstair, and optional self-contained cargo loader ensure maximum 737-200 self-sufficiency.

The cargo loader allows loading at truck bed height. The loader accommodates both military and commercial pallets and is equipped with a ball transfer platform for ease of pallet handling. The maximum elevator capacity is 10,000 pounds (4,535 kilograms) with a nominal load-lifting capacity of 8,000 pounds (3,628 kilograms) at a rate of 0.33 feet (0.10 meters) per second. The loader can be erected in 7 minutes and stowed in 12 minutes. Each pallet can be loaded or off-loaded in about 3 minutes.

The loader is operated by a hand-held control panel and is powered by the 737's APU and/or electrical system. If the electrical system should fail, the loader can be operated manually. When the cargo loader is not in use, it retracts into the aircraft, or it can be removed from the aircraft and stored.

The APU is installed in the tail cone of the fuselage. On the ground, the APU supplies electrical energy as well as bleed air for engine starting and air conditioning. In flight, the APU can provide both air and electrical power if required.



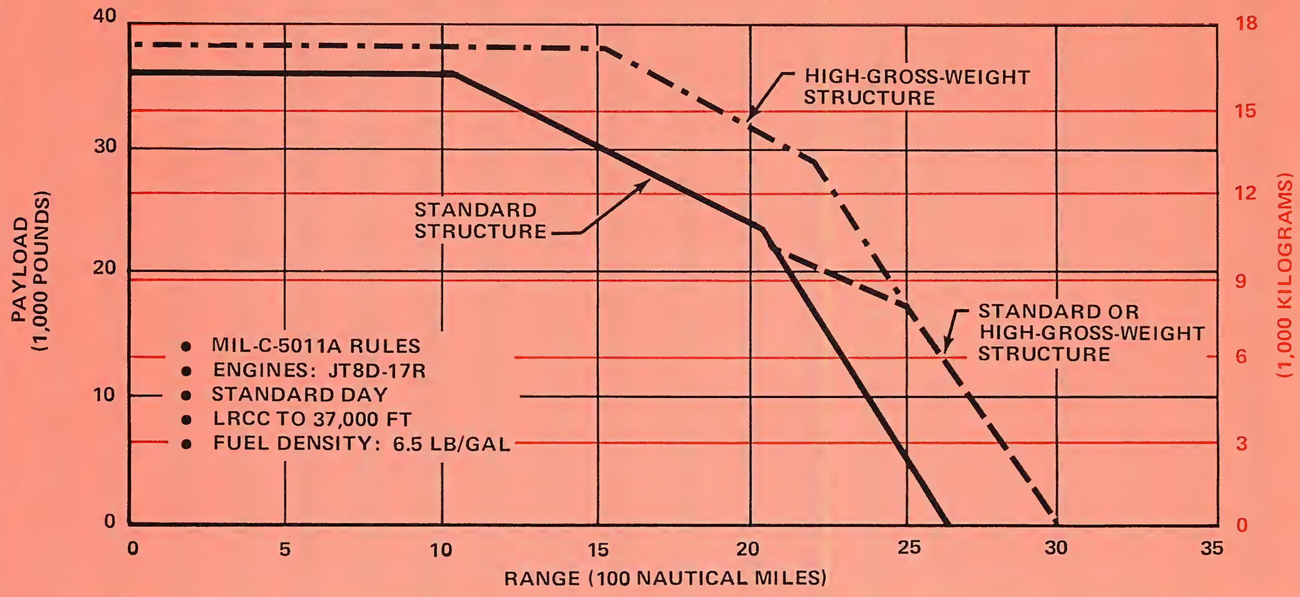
Cargo Transport Payload Range

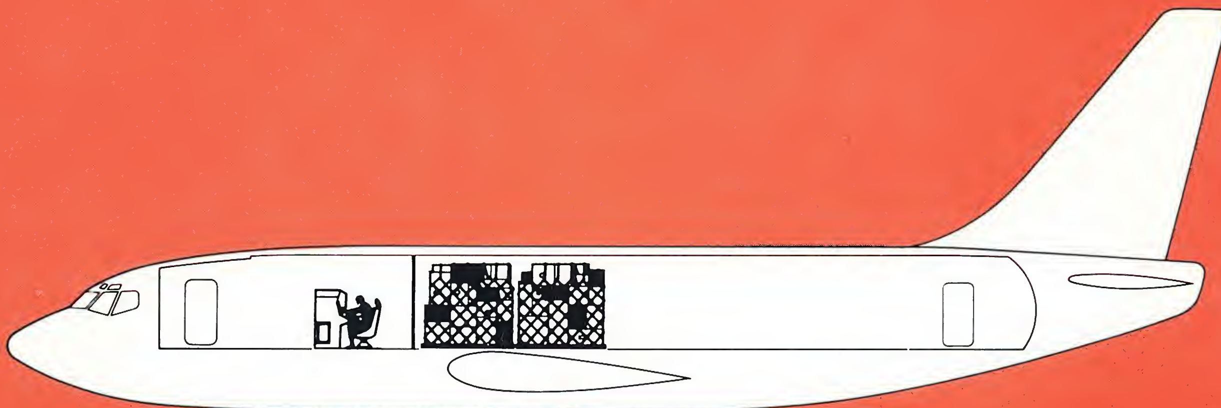
The 737-200 payload and range capability is presented below for the cargo configuration. The effect of optional fuel capacity and high-gross-weight structure is shown.

For example, with standard fuel capacity and structure, the 737 airlifts 35,740 pounds (16,211 kilograms) a distance of 1,020 nautical miles; using the optional high-gross-weight structure, 38,100 pounds (17,282 kilograms) is carried 1,520 nautical miles.

Cargo Transport Payload Range

REFERENCE	STRUCTURE	MAXIMUM RAMP WEIGHT LB (KG)	FUEL CAPACITY U.S. GAL (LITERS)	OPERATING EMPTY WEIGHT LB (KG)
————	STANDARD	117,500 (53,297)	5,164 (19,548)	59,260 (26,880)
— — —	STANDARD	117,500 (53,297)	5,974 (22,614)	60,400 (27,397)
· —— ·	HIGH GROSS WEIGHT	128,600 (58,332)	5,974 (22,614)	60,900 (27,624)





Maritime Patrol

Maritime Patrol

The 737-200 is ideally suited to maritime patrol missions. The spacious fuselage allows installation of various types of surveillance equipment for a multisensor capability. The aircraft can be configured to perform territorial sea surveillance, fisheries surveillance, search and rescue assistance, and weather and environmental patrol duties as well as other ancillary missions. Equipment available for installation includes forward- and side-looking radar, low-light-level television, recording cameras, and other systems required to meet a number of special mission requirements.

In addition to maritime patrol missions, the 737-200 can accomplish a variety of other airborne electronic missions, such as: navigator training, electronic surveillance/countermeasures, navigation, facilities monitoring, or electronic testbed for special applications.

A Large Work Area

The cross-sectional dimensions of the 737-200 allow space for installation of large side-by-side operator consoles. Wide aisles with ample headroom ensure freedom of movement throughout the aircraft with excellent access to doors and emergency exits. The main cabin of the aircraft has 84.5 inches (215 centimeters) of headroom, 687 square feet (63.8 square meters) of usable floor space, and 4,636 cubic feet (131.3 cubic meters) of volume for equipment racks, work areas, and operator personnel.

Operational Advantages

In addition to the spacious main deck, the 737-200 has other features that enable it to effectively perform the maritime patrol mission:

- Oustanding mission range
- Long service life and easy maintenance
- Smooth low-altitude handling and ride quality
- Comfortable cabin environment with low noise levels
- Low-weather-minimum capability

Protection of Fisheries

Regulation of Shipping

Search and Rescue

Comfortable Work Stations

The environmental control system of the 737-200 ensures a comfortable work environment for all missions. Cabin pressure control is automatic, requiring only selection of the intended cruise altitude. The system then programs the most comfortable cabin pressure for the trip.

The aircraft provides an exceptionally smooth ride in turbulent air. Autopilot design features reduce the acceleration forces in the work area, significantly improve the low-altitude ride, and reduce personnel fatigue during turbulent conditions.

Noise levels in the 737-200 are well below normal speech interference levels. Several noise-reducing options are available if the mission requires a further improved acoustical environment.

The vibration environment in the 737-200 is a very low-level, broad-band, random vibration well within personnel comfort levels. Engine sources of vibration are minimized by the decoupling effect of the remote wing-mounted engines and the use of engine vibration isolators.

Mission Equipment

All mission equipment can be fastened to the floor either directly or through the seat tracks. Equipment also can be mounted on cargo pallets for quick installation and removal. All racks and console attachments are normally designed for 16g loads.

The electrical power and equipment cooling systems have substantial reserve capacity to accommodate the electronic equipment required by these missions.

Radar Performance and Display

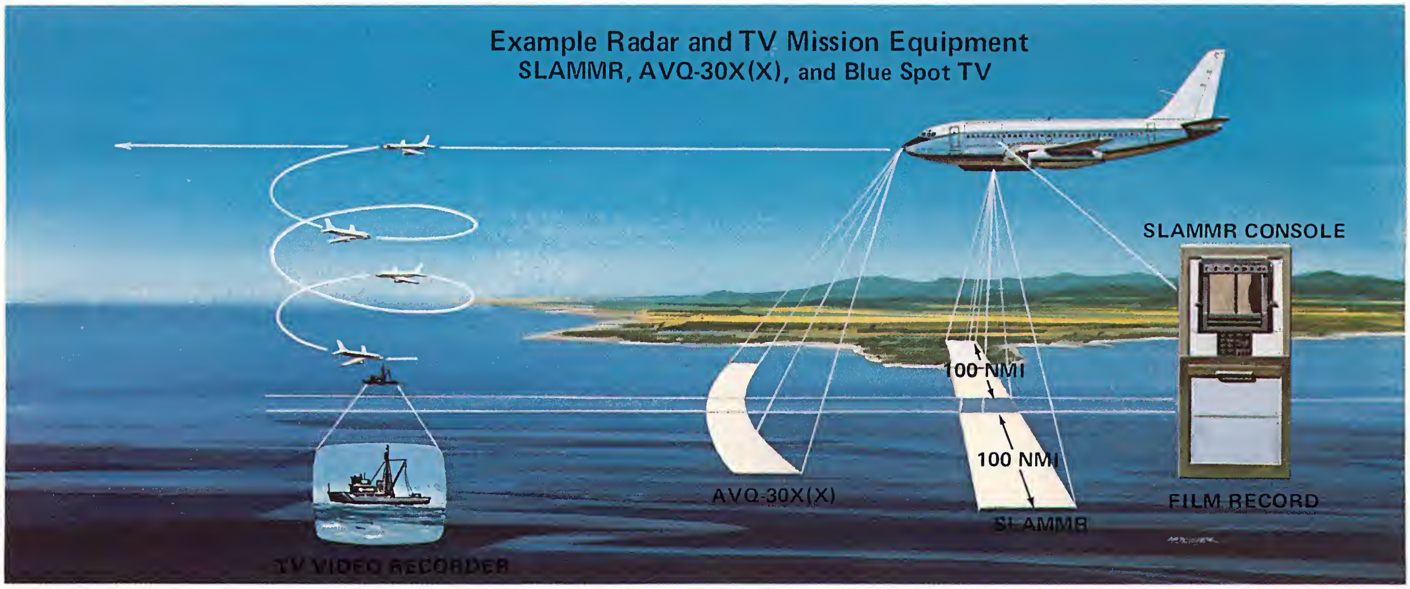
Examples of optional radar equipment for the 737-200 maritime patrol aircraft include the Motorola Side-Looking Airborne Modular Multimission Radar (SLAMMR), a real aperture side-looking radar, and a weather/mapping radar, the RCA AVQ-30X(X).

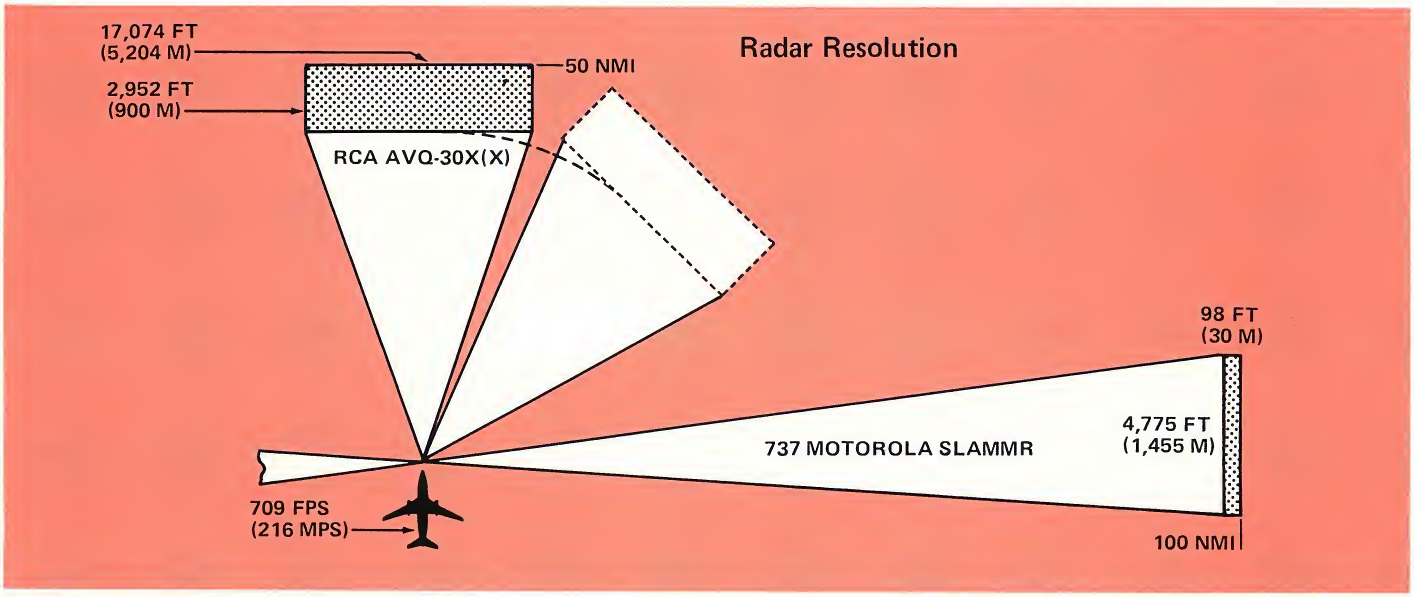
The SLAMMR side-looking radar with a range exceeding 100 nautical miles permits a one-pass survey of the 200-nautical-mile territorial sea areas. The high performance AVQ–30X(X) radar fixes the location of the surface targets so that video records, using the "Blue Spot" television system, can be obtained for identification and proof of territorial sea operations. Characteristics and performance of this equipment are summarized on the following pages.

The SLAMMR has a beam width of 0.45°. The beam (± 3 db) resolves targets to 4,775 feet (1,455 meters) in azimuth at 100 nautical miles. The pulse length is 0.2 microsecond, giving a 98.4-foot (30-meter) resolving capability in range.

The SLAMMR radar integrates returned signals on the film in the display. A cathode ray tube exposes dry process film using fiber optics. Elements of the CRT/film combination are designed so that a single element gets 161 hits at a PRF of 750 pulses per second, range of 100 nautical miles, and an aircraft speed of 420 KTAS.

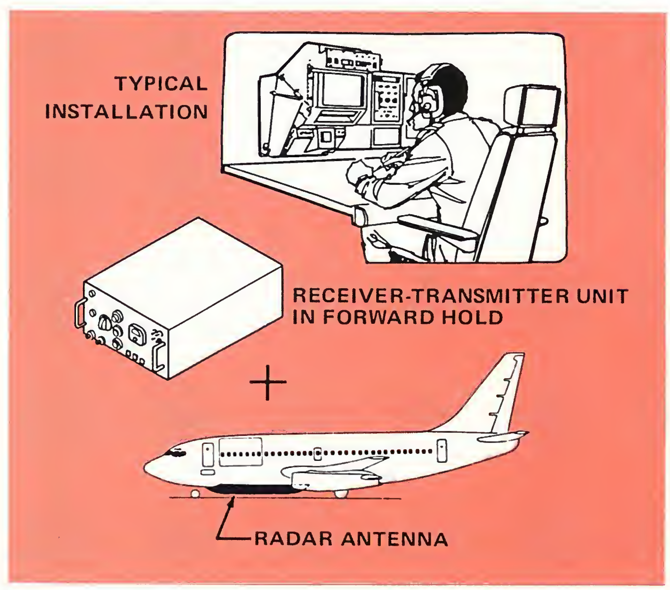
The AVQ-30X(X) beam width is 3.2°, providing a resolving capability of about 17,000 feet (5,182 meters) at 50 nautical miles. Pulse length is 6 microseconds in the most suitable mode for Sea State 4 (other operator-selectable pulse lengths are 1 microsecond and 2.35 microseconds). The range resolving power at 6 microseconds is 2,952 feet (900 meters), at 1 microsecond is 492 feet (150 meters), and at 2.35 microseconds is 1,156 feet (352 meters).



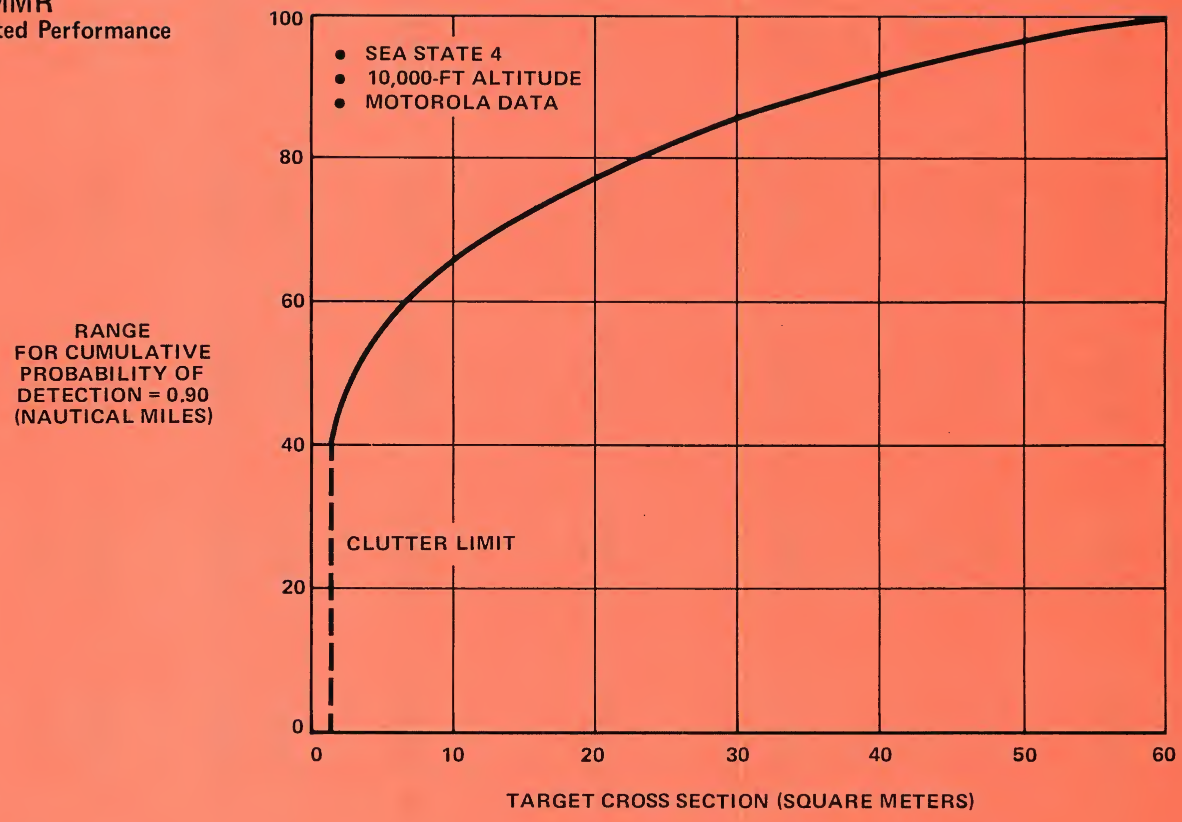


SLAMMR Installation

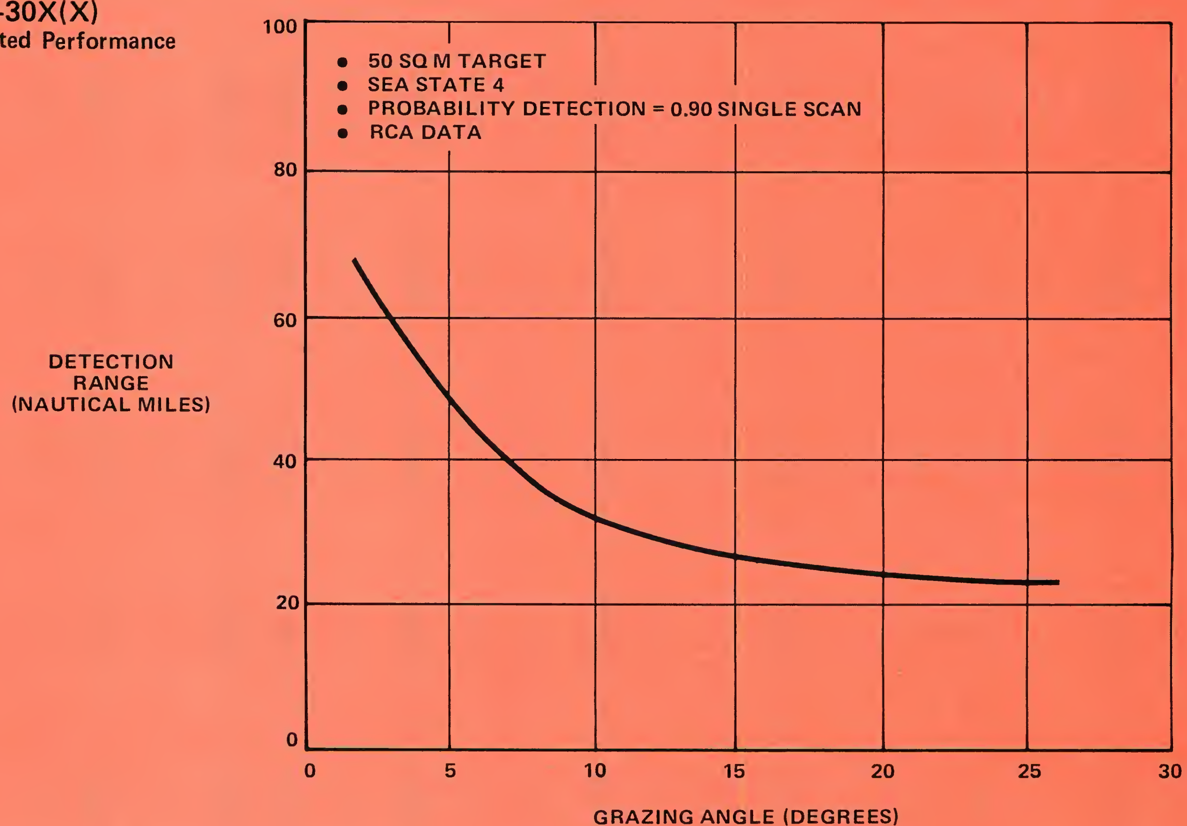
The SLAMMR radar is installed as shown. The electronic equipment on the console controls the beacon interrogator/receiver in the receiver/transmitter unit. The received identification signals are compared to total targets. When the preset threshold number of unknowns is exceeded, the system warns the operator, who then checks to see if most unknowns are left or right of the aircraft. The operator can request a printout of all knowns to compare with the radar plot. Decisions and further investigation are accomplished manually.



SLAMMR
Predicted Performance



AVQ-30X(X)
Predicted Performance



Television

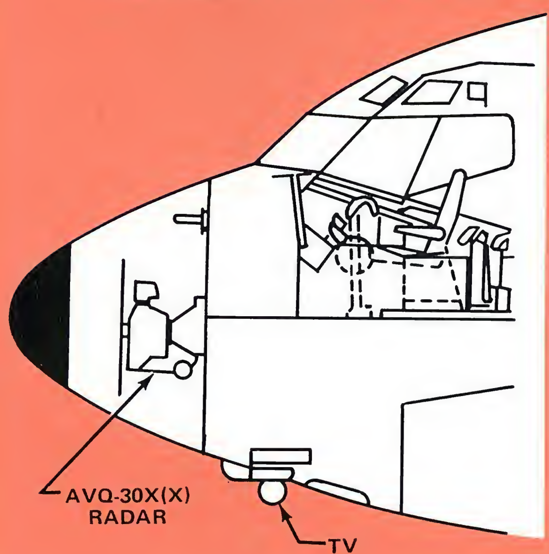
Optional Equipment

The television is a rugged Westinghouse "Blue Spot" system, which is in production for the U.S. Army. It has been modified slightly by deleting a laser designator and increasing the sensitivity by changing the basic sensor. Resultant sensitivity of one foot-candle permits the system to achieve 0.2 milliradian resolution in the narrow-field-of-view mode (5°).

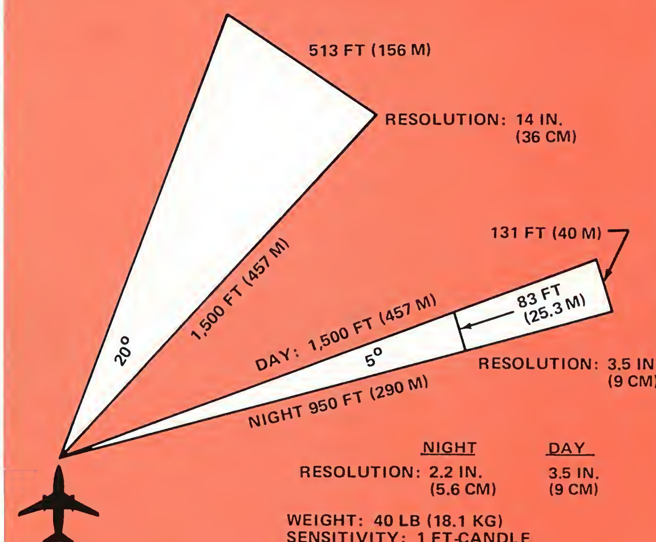
The TV system also includes a video recorder for instantaneous image storage. Television is offered as the most cost-effective approach to visual observation. Required illumination is achieved with lights mounted to illuminate objects abeam. The TV tracking control has trigger-type lights and tape recorder controls. The lights are designed to illuminate targets 950 feet (290 meters) and closer for a time adequate to record them.

The television sensor is chin mounted and steered manually by the operator in both elevation and azimuth. The operator can choose 5° or 20° fields of view. At a 950-foot (290-meter) range, resolution on a narrow field of view is 2.2 inches (5.6 centimeters), adequate for ship signature recording and in most cases identification by name or number.

Nose Radar and TV Installation



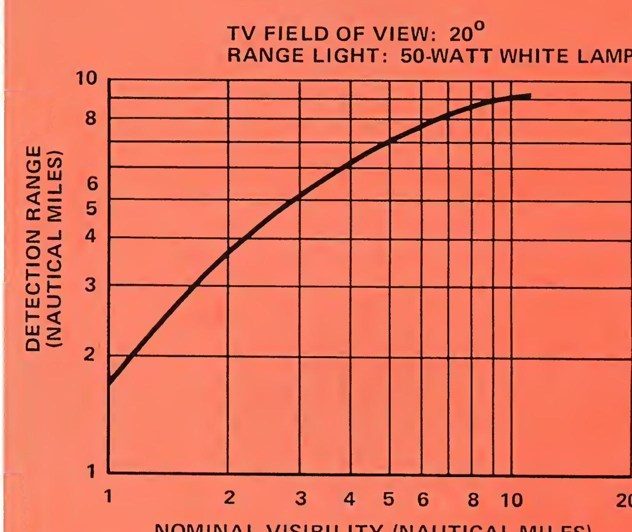
Westinghouse Blue Spot TV



TV Daytime Resolution
Clear Day

Discrimination Tasks	Range (Nautical Miles) Wide FOV	Narrow FOV
Detect Target	2.6	7.8
Recognize as Ship	1.7	7.0
Recognize Superstructure	0.8	3.0
Recognize Ship Type	0.6	2.4
Classify Booms	0.4	1.6
Discern General Activity	0.3	1.0
Discern Detailed Deck Activity	0.2	0.7

Range Light Detection Range

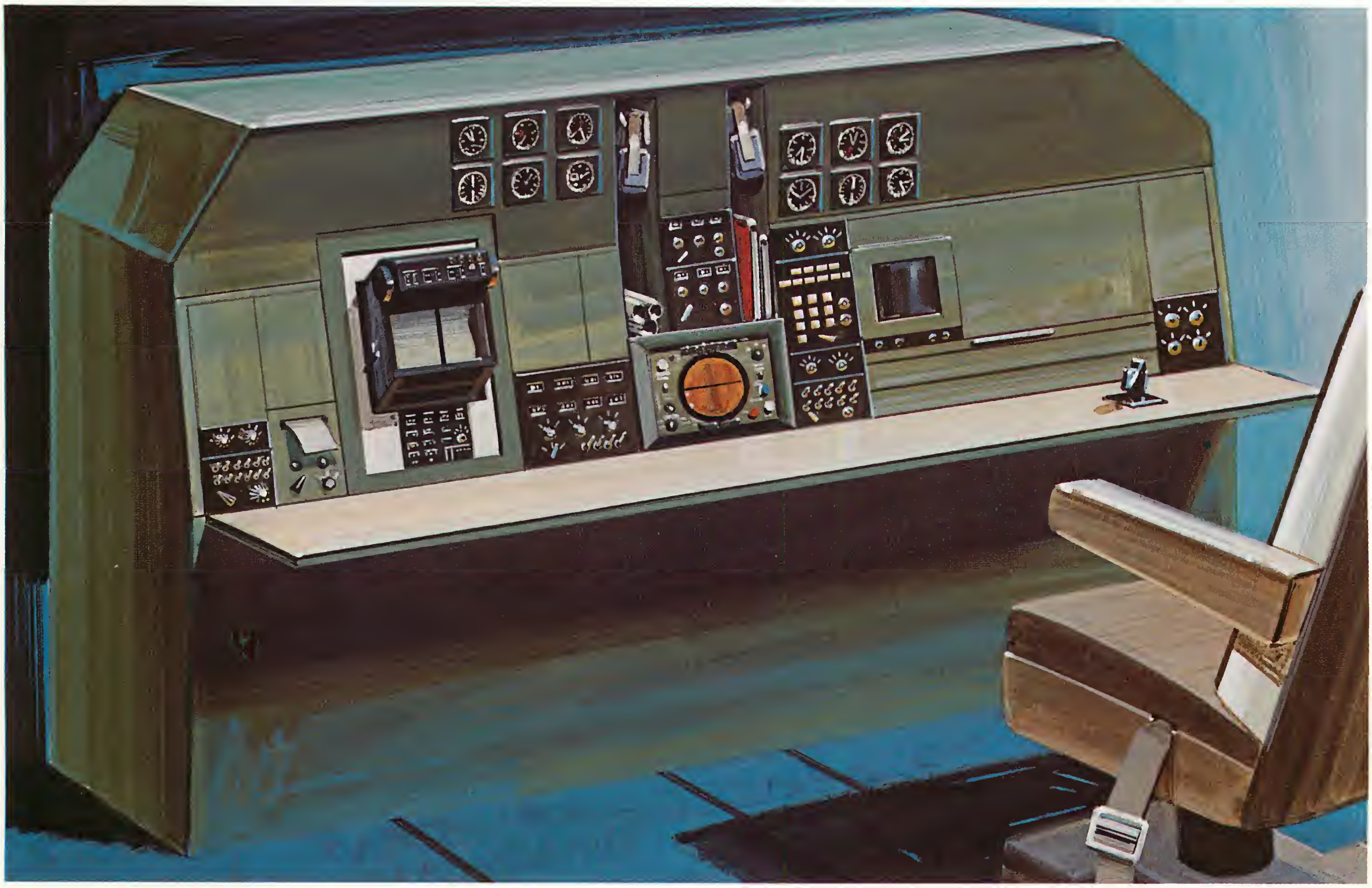


Example Console Operations

A two-man operator team controls the radar and TV mission equipment from a seat-track-mounted console.

The SLAMMR radar display output is hard copy with beacon printout of warning and, upon request, all identified returns when unknowns exceed a preset threshold. Observation of the AVQ-30X(X) PPI CRT scope is required periodically to monitor the 10-nautical-mile area under the aircraft not covered by the SLAMMR. Mission communications are accomplished at the operator console.

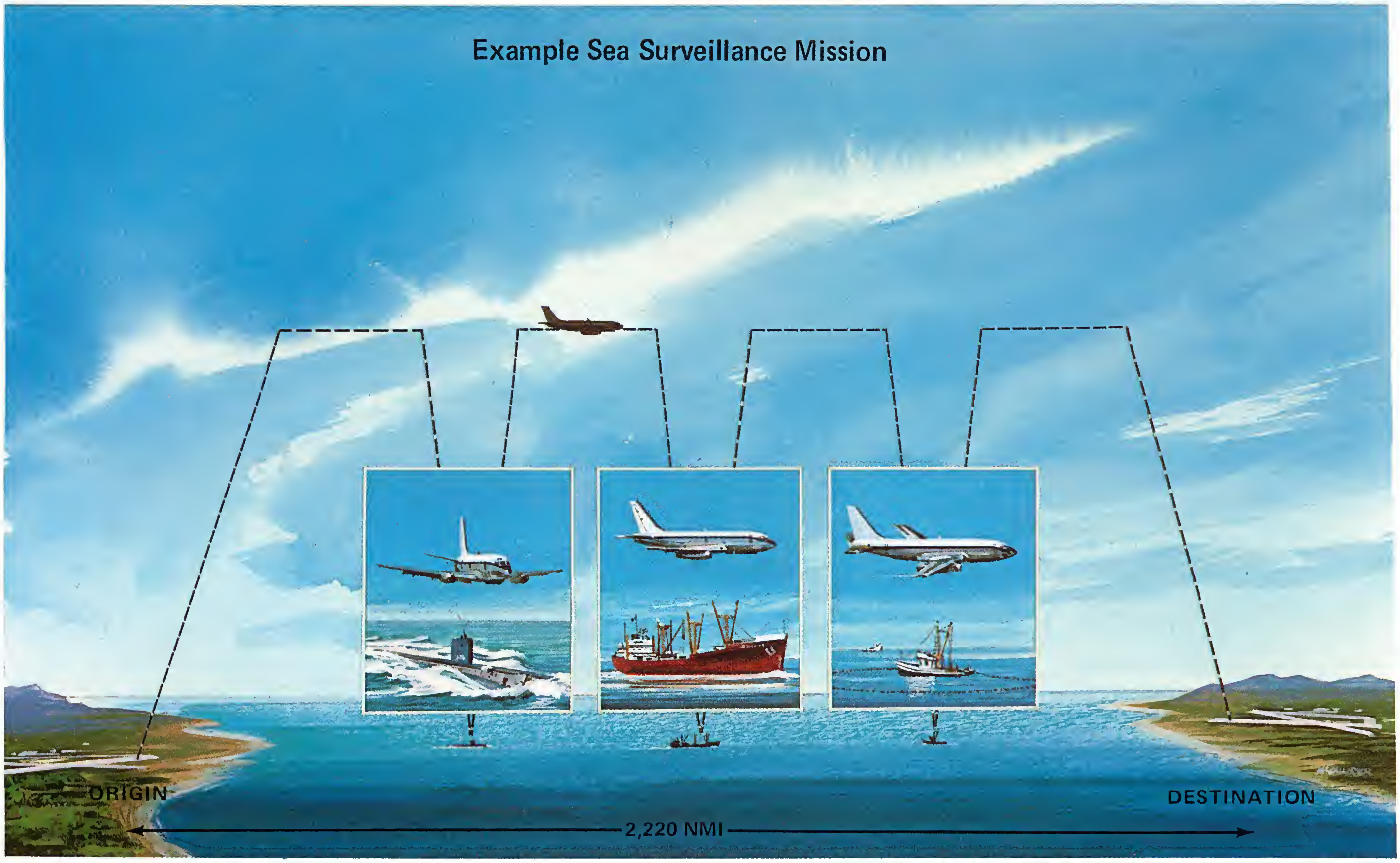
Investigation of unknowns requires a flyby. Bogie position fixing is accomplished by grid location from SLAMMR, then descent, localization with the AVQ-30X(X), and visual observation by eye and TV. Video recording makes permanent records. Television sensor tracking is accomplished using the "TV Track Control." If night operation is needed, the TV will track on ship lights, and flood lights can be triggered for video recording.



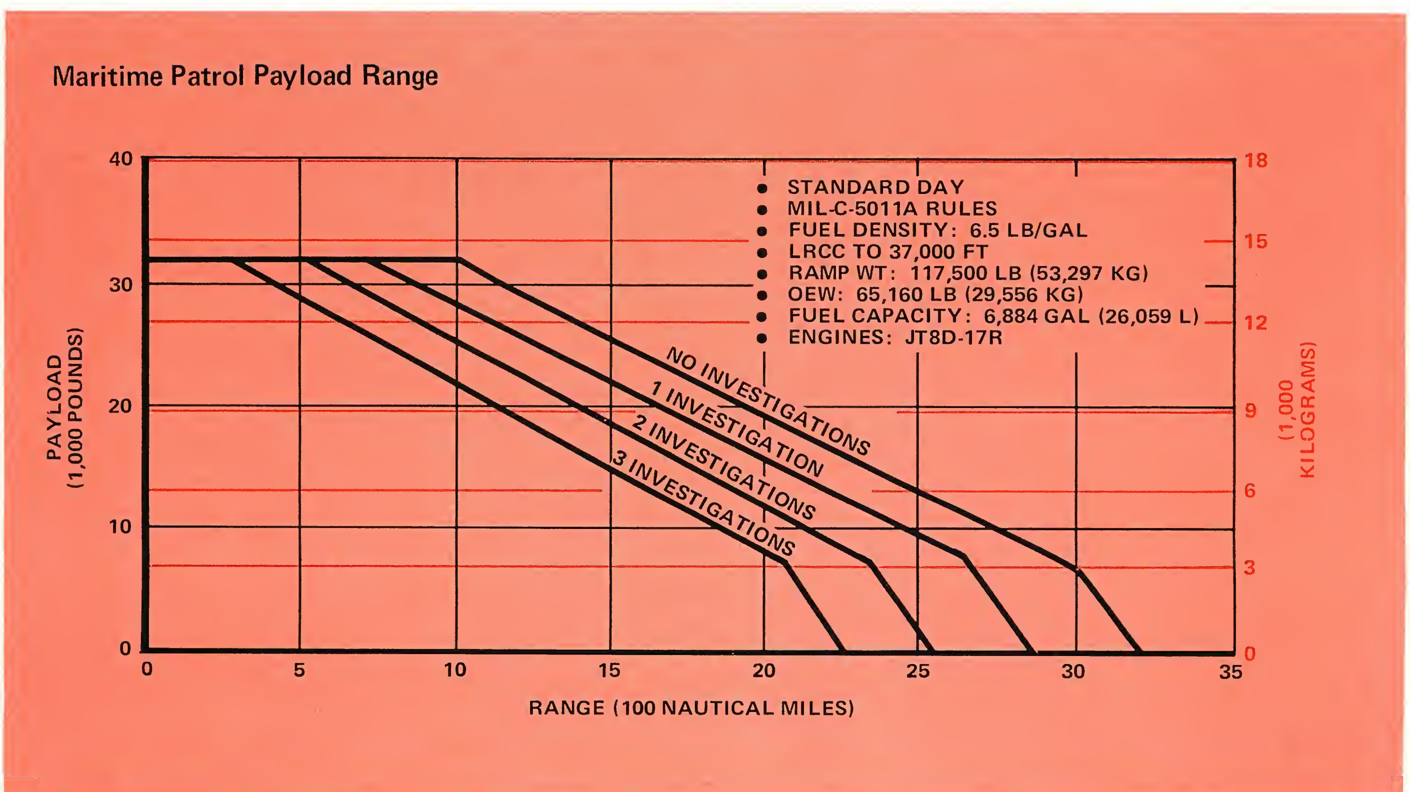
Maritime Patrol Payload Range

The 737-200's range capability in the maritime patrol configuration is shown as a function of payload. Intermediate range lines indicate the range reduction at a given payload resulting from performing one or more contact investigation maneuvers during the mission. In the construction of these curves, fuel allowance for each contact investigation is the total required for descent from cruise altitude to 500 feet altitude, 5 minutes loiter at 500 feet, and an en route climbing return to cruise altitude.

For example, with a 1,000-pound (454-kilogram) mission equipment payload, the 737-200 will, at optimum altitudes, patrol a distance of 2,220 nautical miles and perform three en route contact investigation maneuvers.



- THREE CONTACT INVESTIGATIONS
- STANDARD DAY
- MIL-C-5011A RULES
- OEW: 65,160 LB (29,556 KG)
- FUEL CAPACITY: 6,884 U.S. GAL (26,059 L)
- ENGINES: JT8D-17R
- PAYLOAD: 1,000 LB (454 KG)



Refueling Tanker

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Refueling Tanker

Boeing has produced more than 1,800 tanker aircraft for the United States Air Force. Included are the KB-29, over 800 KC-97s, and more than 700 KC-135s. The KB-29 and KC-97 are both derivatives of the B-29 of World War II; the KC-135 is a descendant of Boeing's 707 prototype and is the backbone of the current U.S. Air Force refueling tanker fleet.

This experience also includes hose/drogue and flying-boom installations on 707 tanker aircraft as well as design of related fuel systems for both. Thus, Boeing has a substantial background for development of the 737-200 refueling tanker.

737-200 Hose/Drogue Tanker Refueling Equipment

The 737-200 can be converted to a tanker by installing Beech model 1080 aerial refueling stores near the wingtips. Refueling rates of up to 300 gallons (1,136 liters) per minute per fighter can be maintained.

With refueling stores on each wing tip, the 737-200 hose/drogue tanker refuels two probe-equipped fighters simultaneously. When refueling operations are completed, the hoses are retracted and the hose booms are raised by a lift cable, resulting in a minimum-drag cruise configuration.

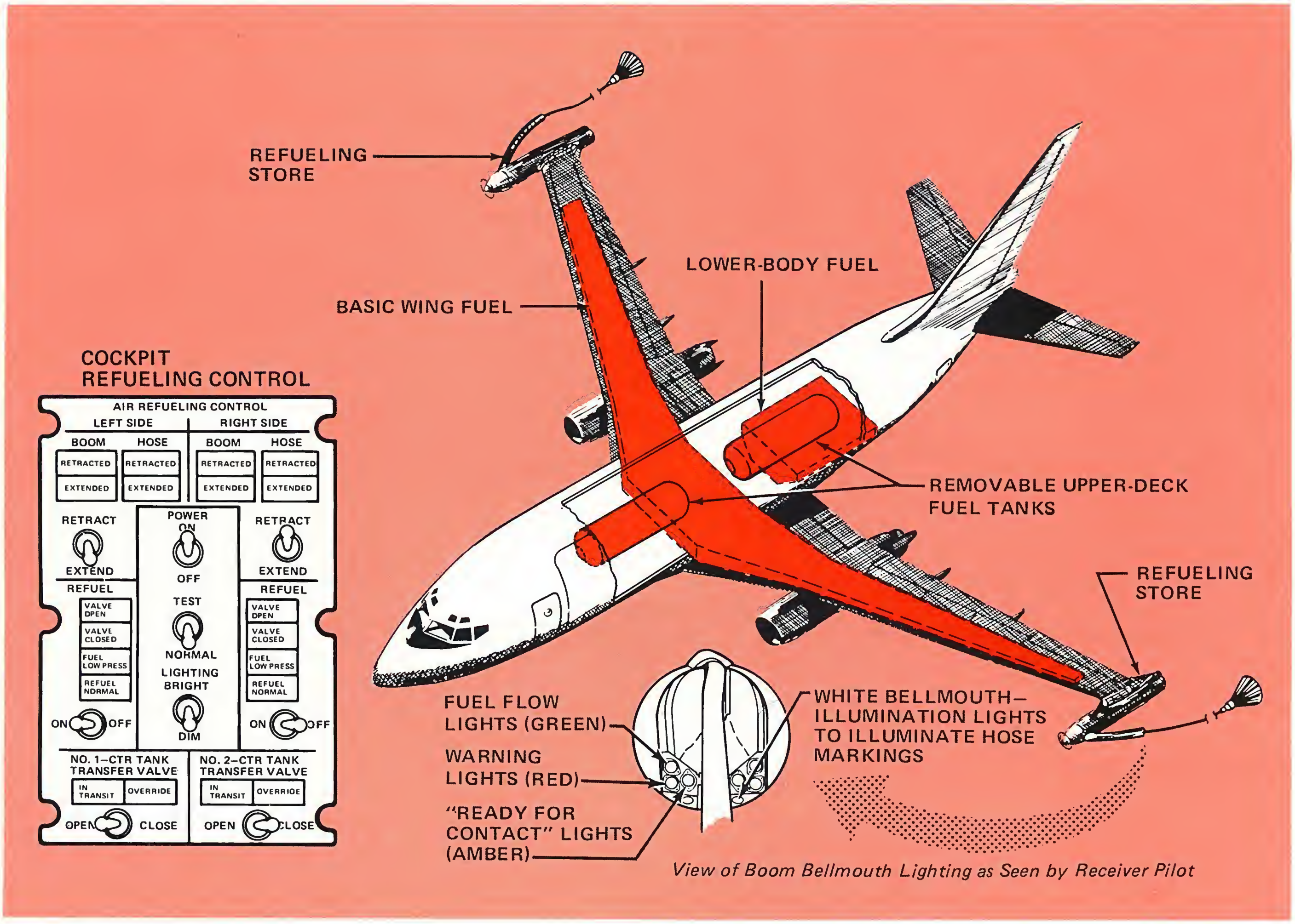
Survey flights in the formating envelope indicate that the model 1080 aerial refueling store with its hose boom places the drogue well below the 737-200's wing vortex, thus ensuring a stable drogue target for the receiver aircraft.

An F-14 fighter is shown being refueled by a 707 tanker.

The hose/drogue system has been in service on 707 tankers with the Canadian Armed Forces more than 6 years and has proven highly successful. Using this proven technology, the same refueling system can be installed on 737-200 aircraft.

The removable wing-tip-mounted refueling pods are fitted with an air-turbine-driven boost pump to provide boost pressure for fuel flow to the receiver. In the retracted position, the boom fairs in with the surface of the pod. The hose is stored around pulleys within the pod. The aft end of the boom is fitted with indicator lights to advise the receiver pilot of hookup and fuel transfer conditions.

Two removable upper-deck fuel tanks of 1,720 U.S. gallons (6,511 liters) each and a 1,070-U.S.-gallon (4,050-liter) lower body tank are added to the basic fuel tankage to provide a total usable fuel capacity of 9,674 U.S. gallons (36,620 liters) for refueling missions.



View of Boom Bellmouth Lighting as Seen by Receiver Pilot

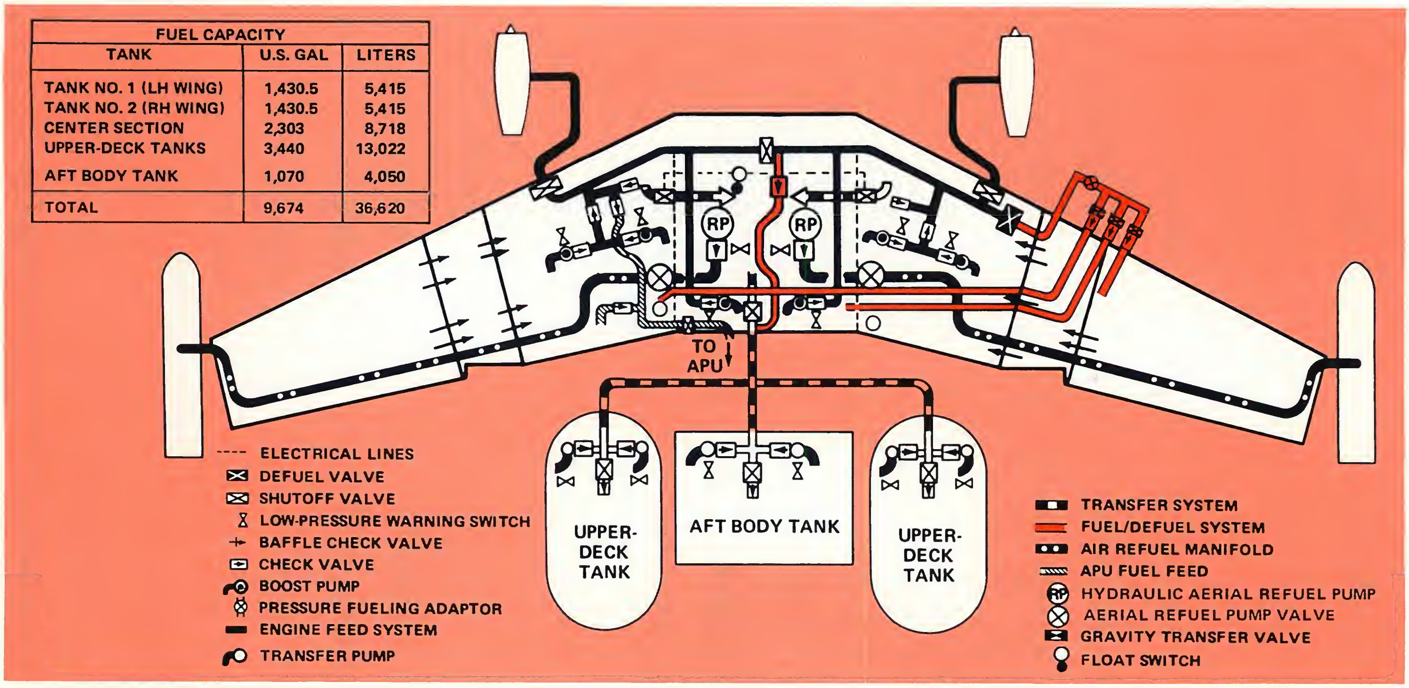
Fuel System Description

The fuel pumped by the aerial refueling system is supplied from the wing tanks, wing center section tank, body tank, and the upper-deck tanks. Two aerial refueling pumps are installed in the wing center section tank and are connected to a 3-inch (7.62-centimeter) aerial refueling manifold running from the pumps through the wing tanks into the wing-tip-mounted Beech stores. At the wing tip, the manifold terminates in a fitting that may be capped when the stores are removed. Each pump is capable of supplying the nominal-rated Beech pod fuel flow capability of 240 gallons per minute (909 liters per minute) at 50 pounds per square inch (3.5 kilograms per square centimeter).

A gravity feed system is provided to permit fuel transfer from the inboard main tanks to the center wing tank. This transfer system consists of a float switch-controlled butterfly valve that links the wing tanks and center section tanks.

During aerial refueling operations, fuel from the upper-deck tanks and the aft body tank can also be pumped to the center wing tank for ultimate transfer to a receiver. The aft body tank and the upper-deck tanks are equipped with two transfer pumps each, providing selective management of fuel transfer from body tanks to center wing tank.

For safety, pressure relief valves are installed in each wing tank. These valves provide additional vent system capacity in the event of an aerial refueling manifold failure. The valves are spring-loaded discs that open at 3.5 pounds per square inch (0.25 kilograms per square centimeter). In the event of a manifold failure, the tank pressure rises when the aerial refueling pump continues to supply enough fuel to fill the tank. The relief valve opens when tank pressure reaches 3.5 pounds per square inch (0.25 kilograms per square centimeter). The valve allows fuel to spill from the tank to the center wing-tank vent line. The fuel may then run back to the center wing tank as well as overboard via the surge tanks.



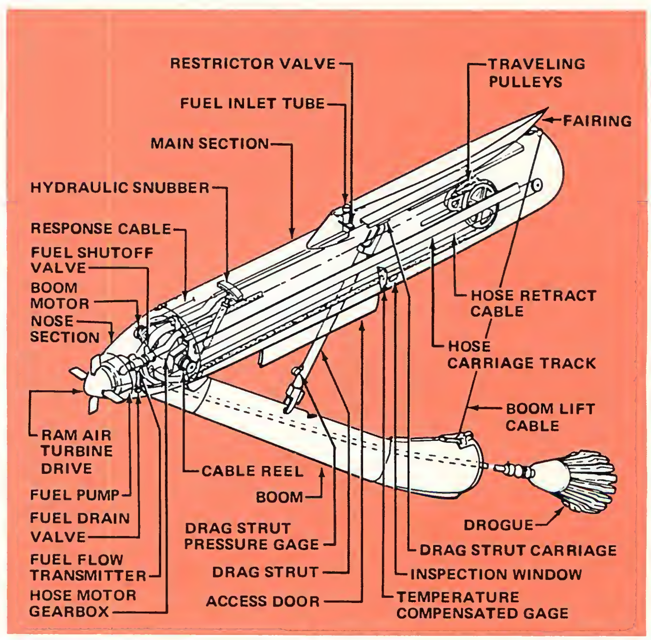
FUEL CAPACITY		
TANK	U.S. GAL	LITERS
TANK NO. 1 (LH WING)	1,430.5	5,415
TANK NO. 2 (RH WING)	1,430.5	5,415
CENTER SECTION	2,303	8,718
UPPER-DECK TANKS	3,440	13,022
AFT BODY TANK	1,070	4,050
TOTAL	9,674	36,620

Aerial Refueling Store Description

The Beech model 1080 aerial refueling store is basically a 25-inch-diameter (63.5-centimeter) cylinder approximately 18 feet (5.5 meters) long. The "boom" arm can be raised and lowered for the refueling operation and is nested for the cruise mode of operation. The hose used to supply fuel to the receiver is located inside the store and is wound around four pulleys before passing through the boom. The end of the boom is shaped to allow stowage of the refueling drogue when nested. Two electric motors are used; one to raise and lower the boom and the other to extend and retract the hose. A fuel boost pump is mounted in the nose of the store and is driven by a four-blade ram-air turbine. Additional equipment such as shutoff valves, fuel flowmeter, and electrical relays are also housed in the store.

The store is attached to the wing by a three-point attachment system. Two forward attachment fittings and one rear fitting transmit loads into the wing front and rear spars. Fuel and electrical connections to the tanker system are easily accessible.

Ventilation to prevent accumulation of fuel vapor is provided by two ram-air scoops in the forward access doors. Drain holes in the store and boom provide drainage and prevent the accumulation of fuel and moisture.



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Aerial Refueling Store Schematic

The schematic diagram shows the systems that provide power for operating the boom and hose and for boosting fuel flow out of the drogue.

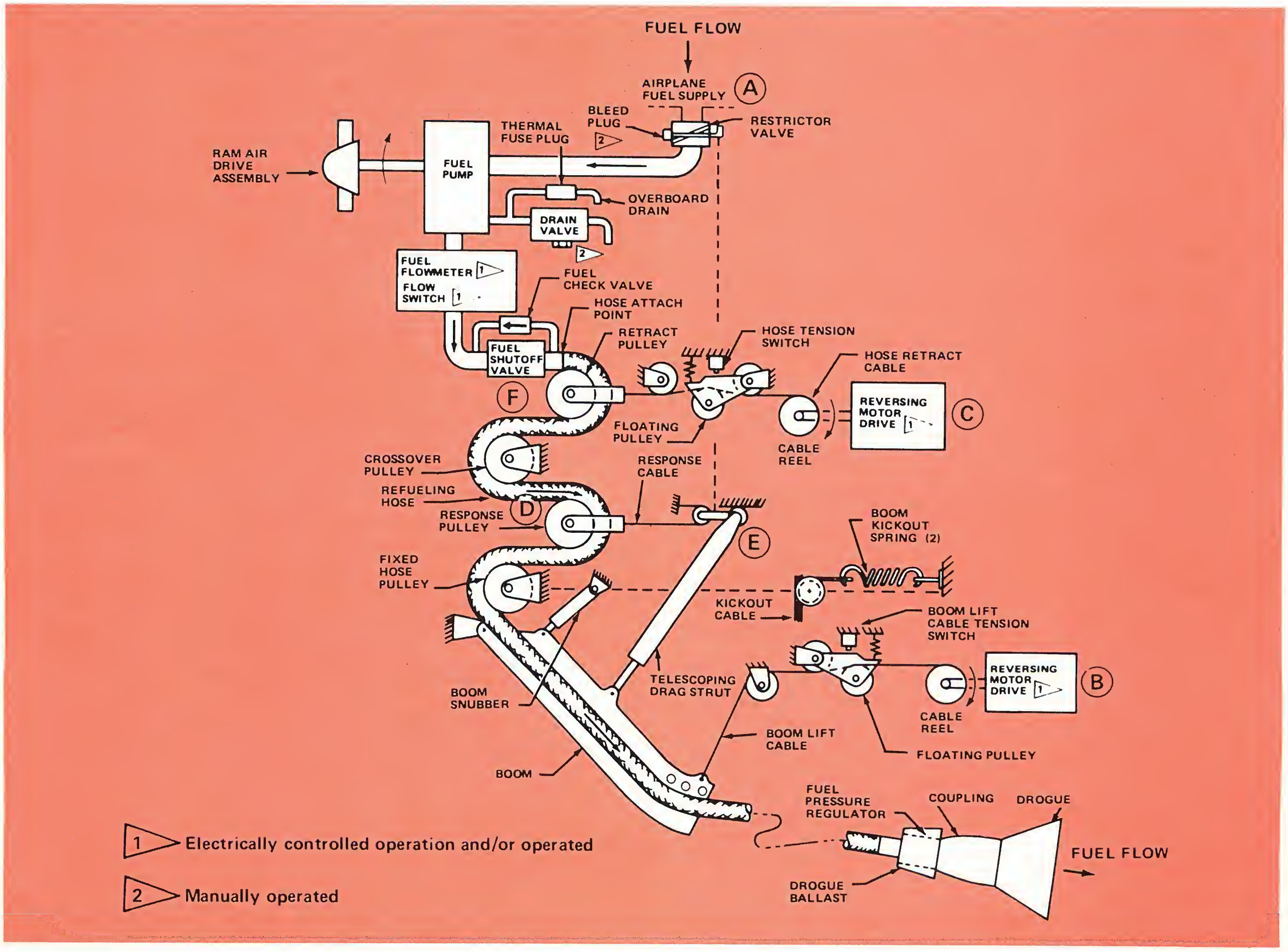
Fuel from the tanker enters the store at point A. From there, the fuel flows forward to the store fuel pump, which is driven by a ram-air turbine. At speeds above 265 knots (equivalent airspeed), this pump boosts the fuel flow out of the drogue to 300 gallons (1,136 liters) per minute with an F-5 receiver. With the ram-air turbine inoperative, the aerial refueling pumps inside the fuel cell of the tanker will transfer fuel to an F-5 at a maximum rate of approximately 170 gallons (644 liters) per minute.

The boom hoist system consists of a motor drive (B) and cable system. This motor unit allows the boom to lower at a controlled rate during extension and lifts the boom for retraction.

The hose extend and retract system consists of a motor drive (C) and cable system, which maintains hose tension on the refueling hose during receiver contact. Tension is maintained by action of the telescoping pressurized drag strut and the response cable. Hose tension resulting from aerodynamic drag of the drogue is sufficient to overpower drag strut pressure and maintain the system at full trail. As the receiver pushes forward on the drogue coupling, hose tension is reduced sufficiently to allow the drag strut to extend, forcing the guide assembly (E) aft against the response cable and pulling the response pulley aft to eliminate slack in the trailing hose.

When the boom switch is placed to "extend," both electric motors in the store operate. Pulley (F) moves forward while pulley (D) momentarily moves aft, because of the overcoming strut pressure. When the strut hits its stops, pulley (F) continues to move forward, relieving the hose tension and allowing the drogue to blossom out of the boom. As pulley (F) continues to move forward and the boom is partially extended, the drag on the hose and drogue overcomes the drag strut pressure, allowing pulley (D) to move fully forward while playing out the remaining hose and completing the cycle.

The retract sequence is the reverse of the above.



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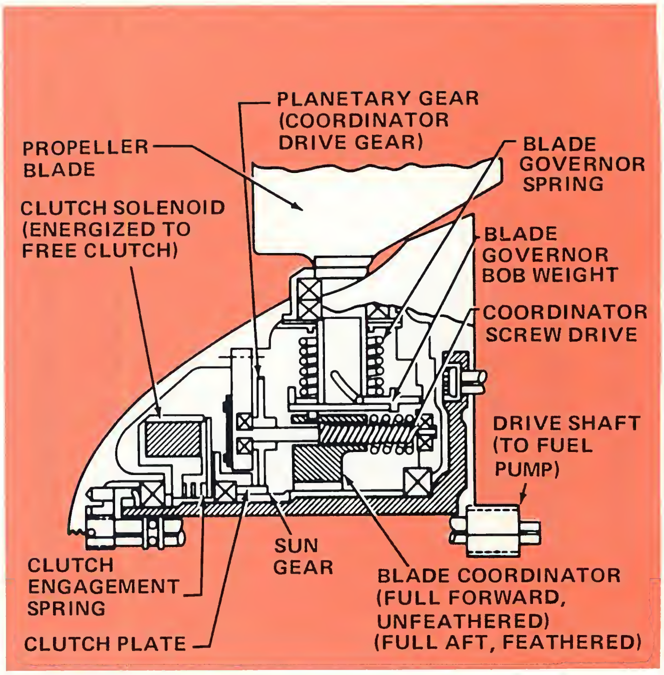
Ram-Air Turbine Description

The ram-air turbine (RAT) consists of a full feathering, constant speed four-blade propeller 18 inches (45.7 centimeters) in diameter and its associated control mechanism. With adequate airspeed, it drives the store fuel boost pump at 4,000 revolutions per minute (rpm), regardless of load. A variable-pitch mechanism controls the blade angle to obtain the 4,000-rpm governed speed.

The feathering mechanism consists of a solenoid-actuated clutch that uses the rotary motion of the unit to drive the blades to a feathered position.

Power is applied to the solenoid to unfeather the blades. A loss of power will automatically engage the clutch and feather the blades.

The ram-air turbine is turned off automatically at low flow rates prior to receiver disconnect to minimize shutoff surge pressures.



Typical Aerial Refueling Operation

After takeoff and prior to the air refueling operation, the aerial refueling system test switch is used to check the operation of the store shutoff valves, the aerial refueling pumps, and the gravity transfer valves. The operational status of the auxiliary "A" system pump and aerial refueling hydraulic control valves is also verified. The RAT switch is actuated momentarily to allow the observers to check operation. Following rendezvous with the receivers, the power switch is turned on and the boom and hose are extended. When fuel transfer is required, the refuel switch is turned on. After the boom and hose are fully extended, the boom amber light illuminates to indicate to the receiver that the system is ready for hookup.

When the receiver hooks up and moves forward 3 feet (0.9 meter), the 3-foot(0.9-meter)-limit switch opens the fuel shutoff valve, which starts the aerial refueling pump, and fuel transfer is initiated. At the 3.5-foot (1.1-meter) point, the position of the store drag strut opens a restrictor valve that allows the fuel flow to increase to approximately 150 gallons (568 liters) per minute. When the receiver has moved in past the 5-foot (1.5-meter) point, the flight engineer selects "RAT ON." This starts the turbine, and the fuel flow rapidly increases to the maximum available. This causes the flowmeter switch to latch the RAT switch in the on position. Refueling continues in this mode until the flow demand of the receiver falls below 150 gallons (568 liters) per minute.

At this point, the RAT switch is automatically unlatched and moves to the off position and the turbine stops. Fuel flow, supplied by the aerial refueling pump, continues until the receiver is fully topped off. The engineer then places the refuel switch to the off position, which closes the store refuel shutoff valve and stops the aerial refueling pump. The valve closure turns the boom green lights off and turns the amber lights on indicating to the receiver that fuel flow has stopped. The receiver can then disconnect.

A receiver-initiated disconnect, either normal or emergency, results in a different sequence of operation. As the receiver moves aft, the following sequence occurs: At the 5-foot (1.5-meter) position, the 5-foot (1.5-meter) switch initiates a RAT shutdown. At the 3.5-foot (1.1-meter) position, the restrictor valve closes, thereby reducing fuel flow to minimize surging. At the 3-foot (0.9-meter) position, the 3-foot(0.9-meter)-limit switch initiates closure of the shutoff valve and aerial refueling pump shutdown. The receiver then disconnects and if no further transfer is required, the refuel switch is turned to the off position.

The boom and hose are then retracted and, when fully stowed, the power switch is placed in the off position.

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Refueling Store on Test Stand

The refueling store is shown mounted on a portable field test stand for functional test. The boom is fully extended and the hose/drogue assembly is partially extended.

Boom Configuration

For refueling of receptacle-equipped fighters, a retractable boom and a boom operator's compartment are installed on the aft fuselage of the 737-200 tanker.

The boom operator maneuvers the boom for engagement with the fighter refueling receptacle by movement of the boom aerodynamic control surfaces.

When not in use, the boom is retracted and raised to the stowed position below the aft fuselage.

®

Refueling a Typical Receptacle-Equipped Fighter

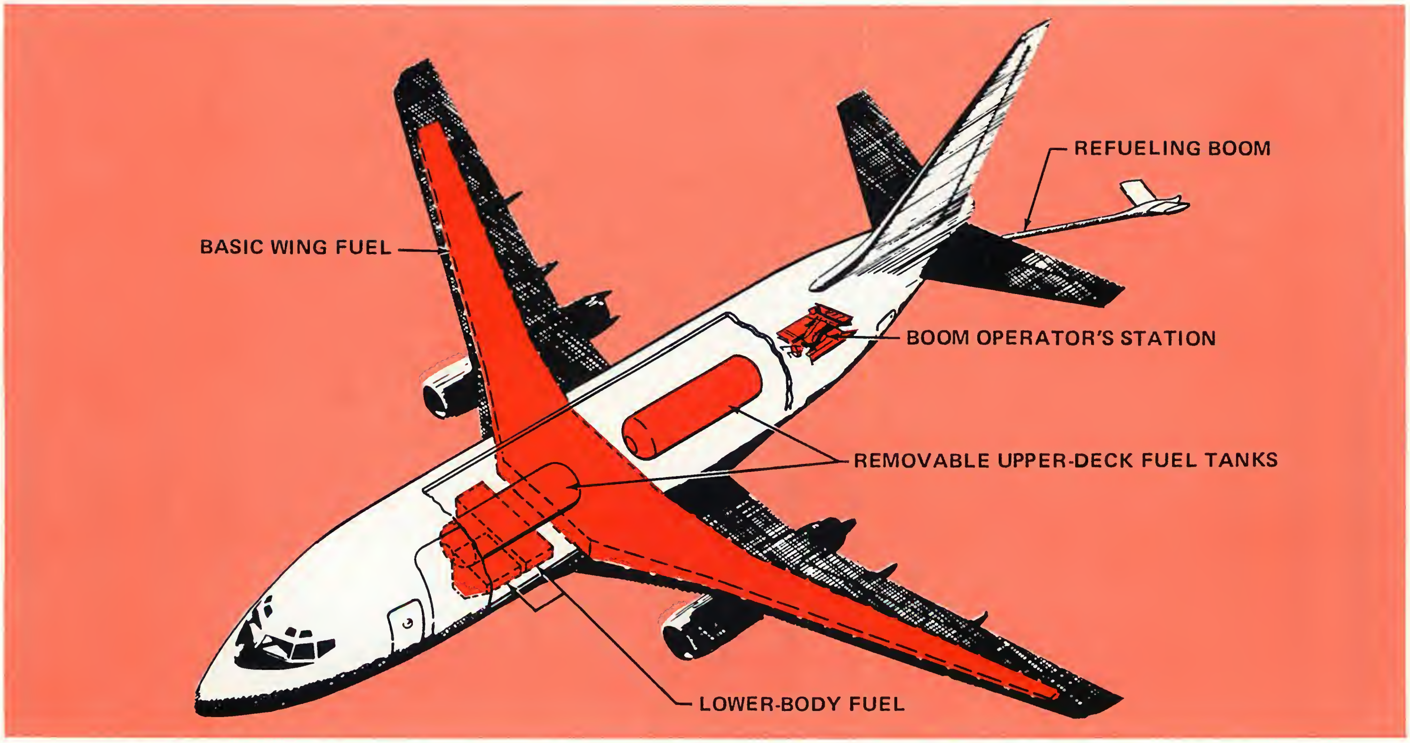
An F-4 Phantom fighter is shown during in-flight refueling. Boom-equipped tanker aircraft produced by Boeing are in service with the United States Air Force and the air forces of other nations.

The boom shown is installed on a Boeing 707 tanker aircraft operated by the Imperial Iranian Air Force. The same configuration is equally applicable for installation on 737-200 tanker aircraft.

737-200 Boom Tanker Refueling Equipment

The 737-200 boom tanker fuel tankage arrangement is similar to that used in the hose/drogue tanker.

Basic wing fuel and removable upper-deck tanks are identical. Two body tanks are installed in the forward lower baggage compartment. Total fuel capacity for the boom tanker configuration is 9,534 U.S. gallons (36,090 liters) compared to 9,674 U.S. gallons (36,620 liters) for the hose/drogue configuration.



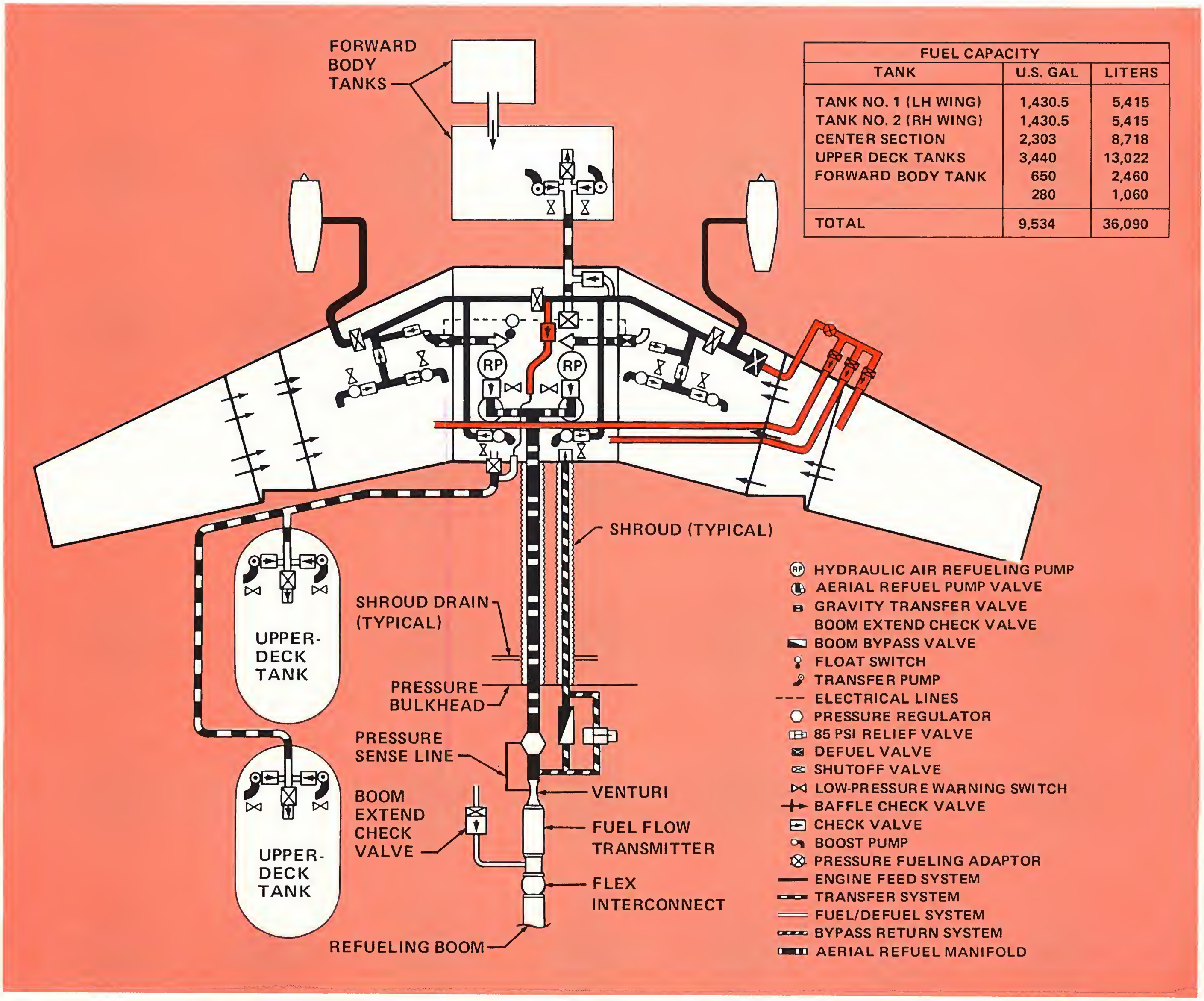
Fuel System Description

The fuel transferred by the boom refueling system is supplied from the wing tanks, wing center section tank, lower-body tanks, and the upper-deck tanks. Two aerial refueling pumps installed in the wing center section tank are connected to a 4-inch (10.2-centimeter) shrouded aerial refueling manifold running from the pumps through the aft body to the aerial refueling boom. At the boom, the manifold terminates at an interconnect that may be capped when the boom is removed. Total flow capacity through the boom is 600 gallons (2,271 liters) per minute at 50 pounds per square inch (3.5 kilograms per square centimeter).

A gravity feed system is provided to permit fuel transfer from the inboard main tanks to the center wing tank. This transfer system consists of a float switch-controlled butterfly valve that links the wing tanks and center-section tanks. The forward lower-lobe tanks are also interconnected by a gravity feed line that permits the 280-gallon (1,060-liter) tank to empty into the 650-gallon (2,460-liter) tank.

During aerial refueling operations, fuel from the body tanks can also be pumped to the center wing tank for ultimate transfer to a receiver. One lower-lobe tank and both upper-deck tanks are equipped with two transfer pumps each, which permits selective management of fuel transfer from body tanks to center wing tank.

A bypass return line is connected in parallel with the refueling manifold to protect it against pressure surges during receiver disconnect. When a disconnect occurs, an electrical signal from the boom opens the boom bypass valve and initiates pump shutdown. Fuel between the pumps and the boom is diverted to the center wing tank via the bypass return line, alleviating a surge. A relief valve is also provided in parallel with the boom bypass valve for added surge protection in the event of a failure of the boom bypass valve.



FUEL CAPACITY		
TANK	U.S. GAL	LITERS
TANK NO. 1 (LH WING)	1,430.5	5,415
TANK NO. 2 (RH WING)	1,430.5	5,415
CENTER SECTION	2,303	8,718
UPPER DECK TANKS	3,440	13,022
FORWARD BODY TANK	650	2,460
	280	1,060
TOTAL	9,534	36,090

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Refueling Boom and Operator's Station

Structural modifications required for conversion of the basic 737-200 to the boom refueling configuration include modification of the aft fuselage for installation of the boom and modification of the aft cargo compartment to incorporate the boom operator's station. The boom mounting structure is added adjacent to an existing structural bulkhead.

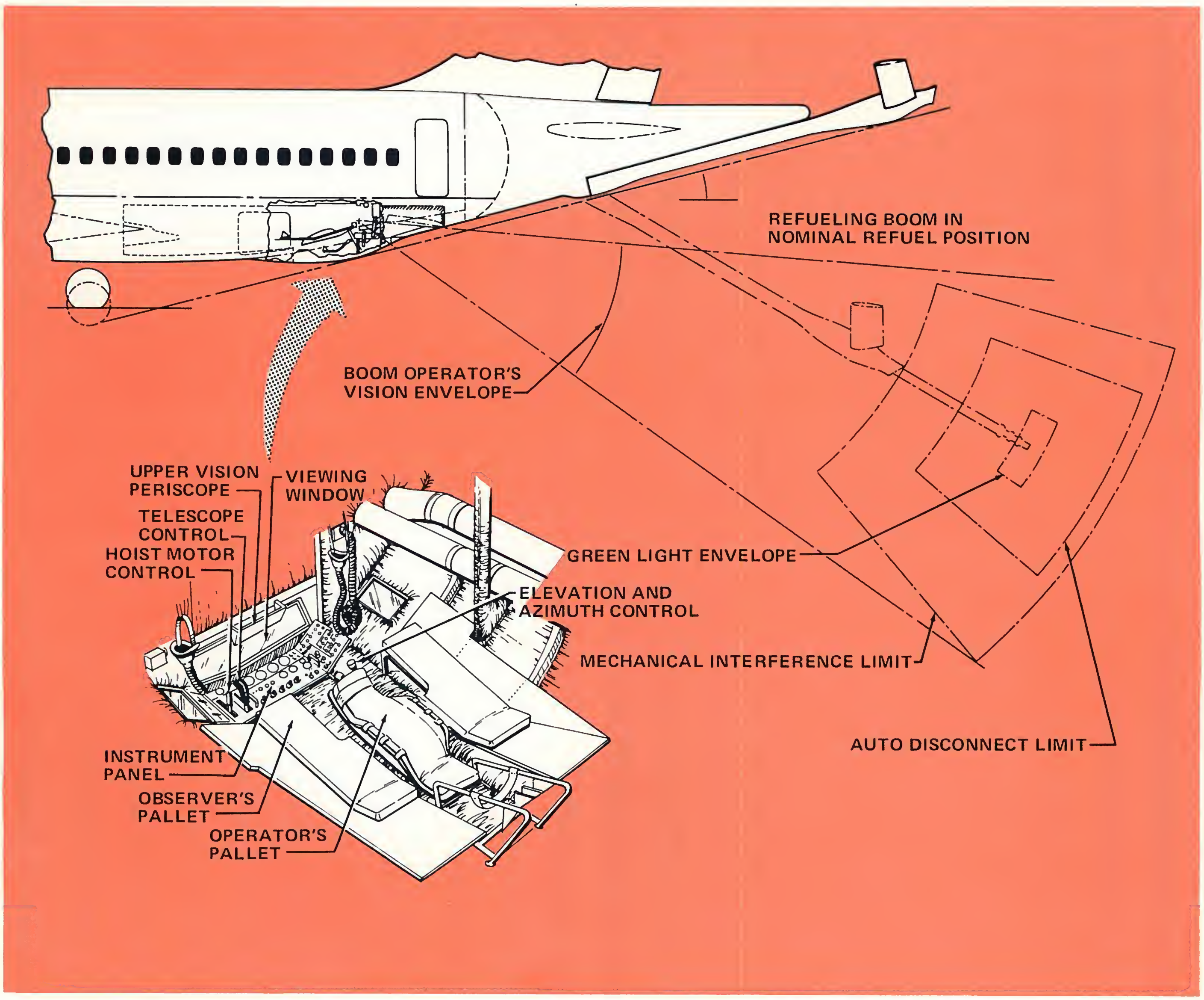
The boom operator's station enclosure is formed by addition of a new pressure bulkhead containing a viewing window at the aft end of the aft cargo compartment. New fuselage skin panels form a revised lower contour in this area.

The viewing window and control panel enable the boom operator to clearly view, monitor, and control refueling operations. The entire boom mechanical interference envelope lies within viewing limits. Additional windows and a periscopic device provide viewing sideward and directly rearward.

A door below and aft of the viewing window is retracted during refueling operations. This door protects the viewing window from dirt accumulation during ground operations and provides aerodynamic fairing of the body below the window. The door also contains smaller windows that provide the boom operator sufficient viewing to accomplish a refueling hookup in the event of door retraction mechanism failure.

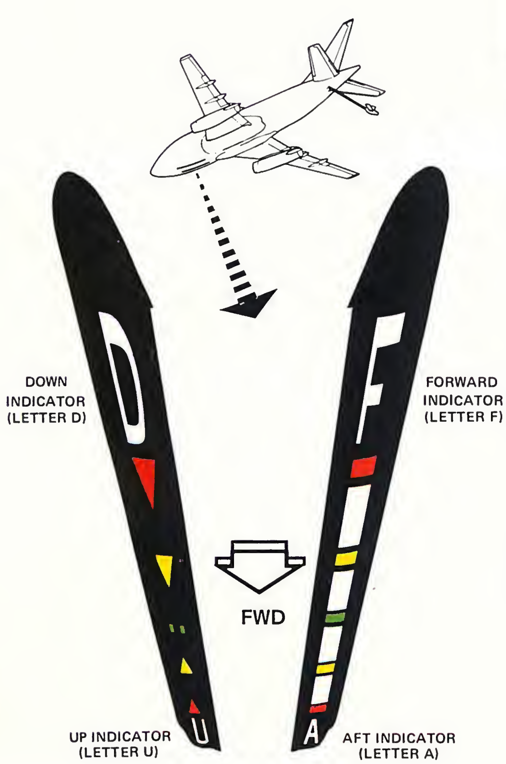
Access to the boom operator's compartment is provided through openings in the main-deck floor above the compartment. Structural panels cover these openings to provide floor continuity for cargo and troop transport missions.

The receiver pilot is guided to the proper refueling position by director lights on the underside of the tanker fuselage. Light signals direct the receiver forward or aft as well as up or down. The function of the director light system is shown in the schematic diagrams on the following page.

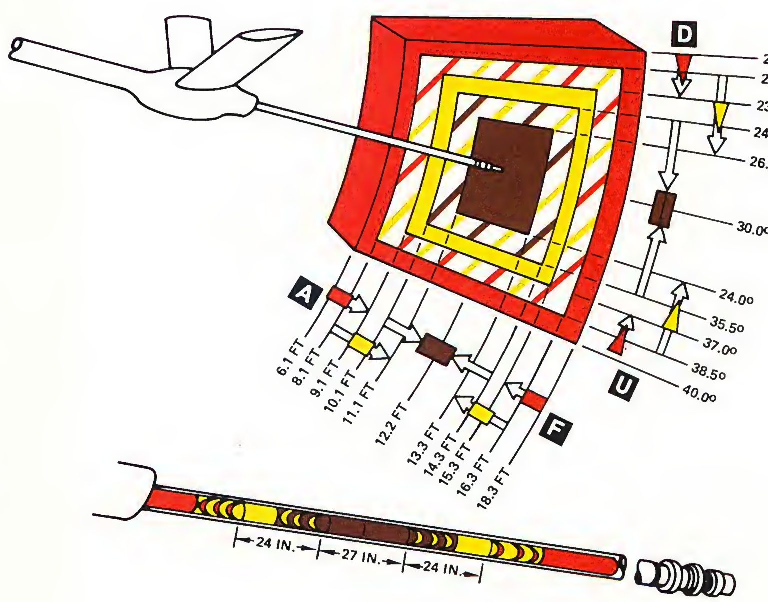


Fighter Aircraft Approaching Refueling Boom As Viewed by Boom Operator

Receiver Pilot Director Lights

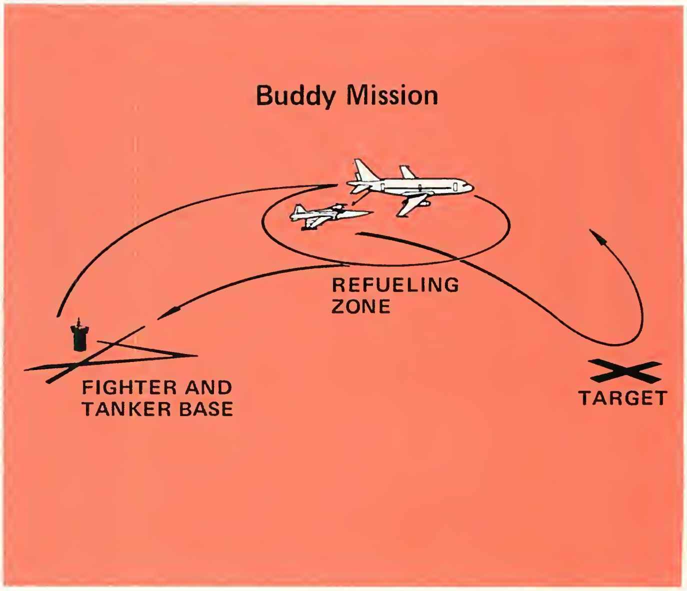


Receiver Director Lights Illumination Profile



737-200 Fuel Transfer Capability

Fuel transfer capability versus radius for the 737-200 tanker is illustrated for both buddy and rendezvous refuel rules.

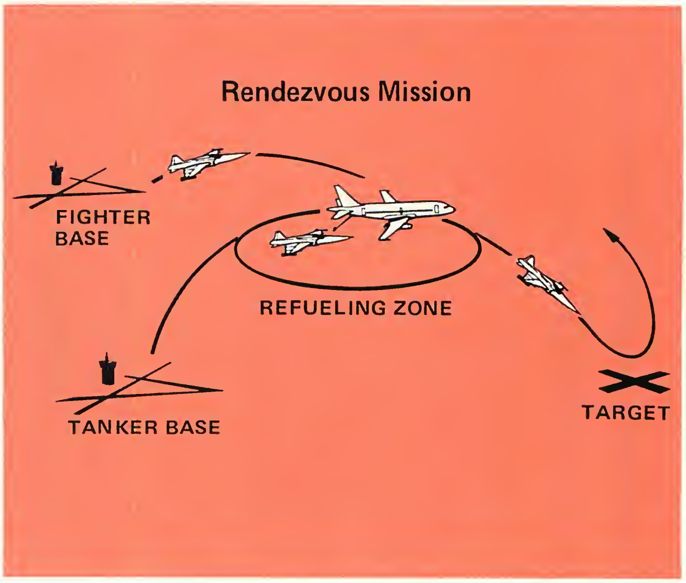


Buddy Refueling Mission

Under buddy refueling rules, the fighters and tanker depart from the same base and fly at the same true airspeed to the refueling zone. After the final refueling operation, the tanker may return with the fighters to the base of origin or to an alternate base within radius.

For example, if a total of 27,370 pounds (12,415 kilograms) of fuel has been transferred at a refueling zone 1,000 nautical miles from base, the tanker can then return to any base within 1,000 nautical miles from the refueling zone.

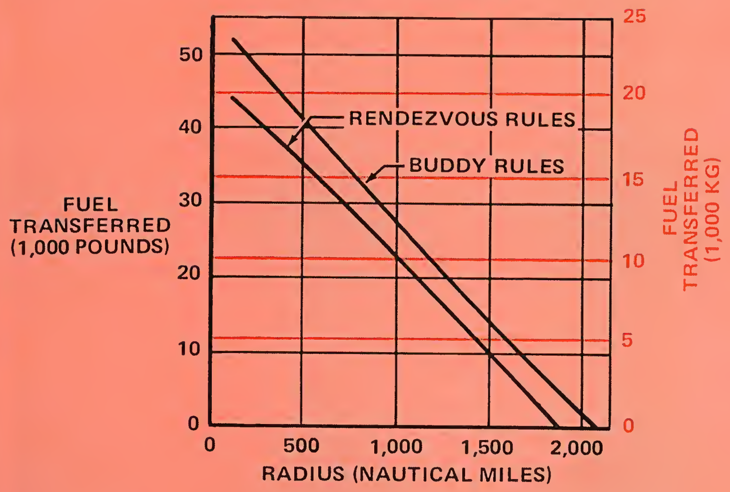
The buddy mission offers the advantage of flexible route selection and route changes during the mission.



Rendezvous Refueling Mission

In the rendezvous mission, the fighters and tanker depart from separate bases and proceed independently to the refueling zone, where the tanker orbits during refueling operations. After completion of refueling operations, the tanker may return to its origin base or another base within the radius shown.

Fuel Transfer Capability



- CURVES APPLY TO BOTH BOOM AND HOSE/DROGUE CONFIGURATIONS
- STANDARD DAY
- ENGINES: JT8D-17R
- LONG-RANGE CLIMBING CRUISE TO 37,000 FT (11,278 M)
- FUEL DENSITY: 6.5 LB/GAL

MIL-C-5011A BUDDY REFUEL RULES
- 10-MINUTE HOLD AT ALTITUDE
- HOOKUP ALLOWANCE: 5% FUEL BURNED PRIOR TO REFUEL
- LANDING RESERVE: ½-HR HOLD AT SEA LEVEL PLUS 5% FUEL BURNED AFTER REFUEL
- 5% CONSERVATISM IN ALL FUEL FLOW
- REFUEL AT MACH 0.7 AT 25,000 FT (7,620 M) WITH DISTANCE CREDIT

MIL-C-5011A RENDEZVOUS REFUEL RULES
- 1-HOUR HOLD PRIOR TO REFUEL
- RESERVES: ½-HR HOLD AT SEA LEVEL PLUS 5% FUEL BURNED
- 5% CONSERVATISM IN ALL FUEL FLOW
- REFUEL AT MACH 0.7 AT 25,000 FT (7,620 M) WITH NO DISTANCE CREDIT

Configuration	Fuel Capacity	Ramp Weight	OEW	Refuel Rate
Boom	9,534 U.S. Gal (36,090 L)	130,540 Lb (59,212 Kg)	68,570 Lb (31,103 Kg)	600 GPM (2271 LPM)
Hose/Drogue	9,674 U.S. Gal (36,620 L)	130,280 Lb (59,094 Kg)	67,400 Lb (30,572 Kg)	480 GPM (1817 LPM)

Refueling Compatibility

A refueling compatibility envelope defines the spectrum of speed/altitude conditions for refueling typical modern jet fighters with the 737-200 tanker. The 737-200 tanker can transfer fuel in the conditions most desirable for the fighter force; i.e., at high altitudes and high airspeed. Refueling at higher altitudes is desirable from the tactical standpoint as well as for weather and fuel economy considerations.

The 737-200 can refuel at speed and altitude combinations bounded by the maximum speed line at the right and the line at the left illustrating minimum speed for Beech store fuel boost pump operation. The 737-200 tanker offers a large refueling envelope extending upward beyond 30,000 feet.

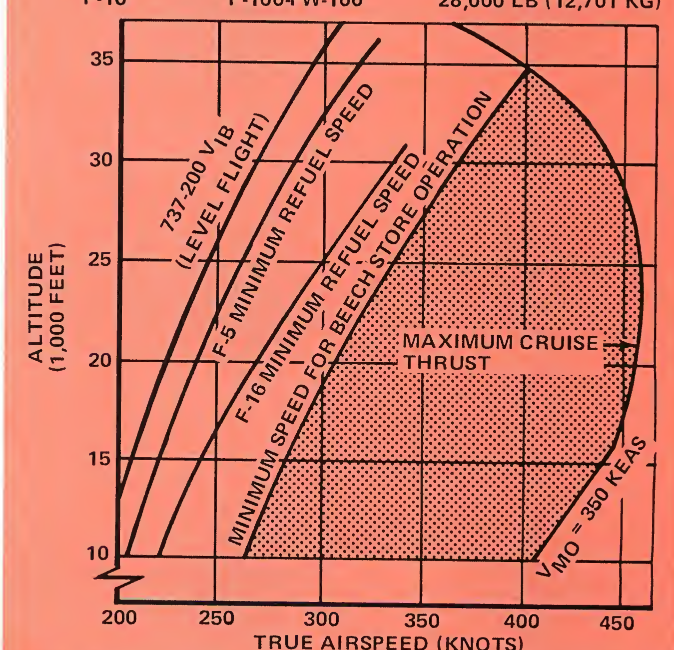
Margin-to-initial-buffet speed lines are also shown at the left for typical jet fighters, the F-16 and F-5. Refueling speeds for these fighters are in the area to the right of their respective minimum refuel speeds.

At a typical refueling altitude of 25,000 feet, the 737 refueling true airspeed ranges from 340 to 460 knots.

Refueling Compatibility
Level Flight

- STANDARD DAY
- TANKER HAS 2 REFUEL DROGUES DEPLOYED
- AIRPLANE / ENGINE / GROSS WEIGHT

AIRPLANE	ENGINE	GROSS WEIGHT
737	JT8D-17R	100,000 LB (45,359 KG)
F-5E	J85-GE-21	15,000 LB (6,804 KG)
F-16	F-100-PW-100	28,000 LB (12,701 KG)



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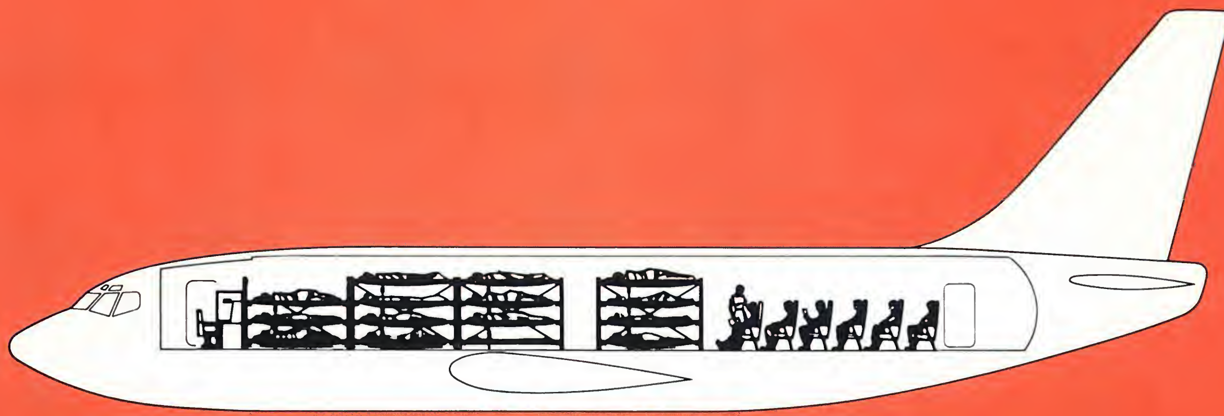


Civil Disaster Relief

Civil Disaster Relief

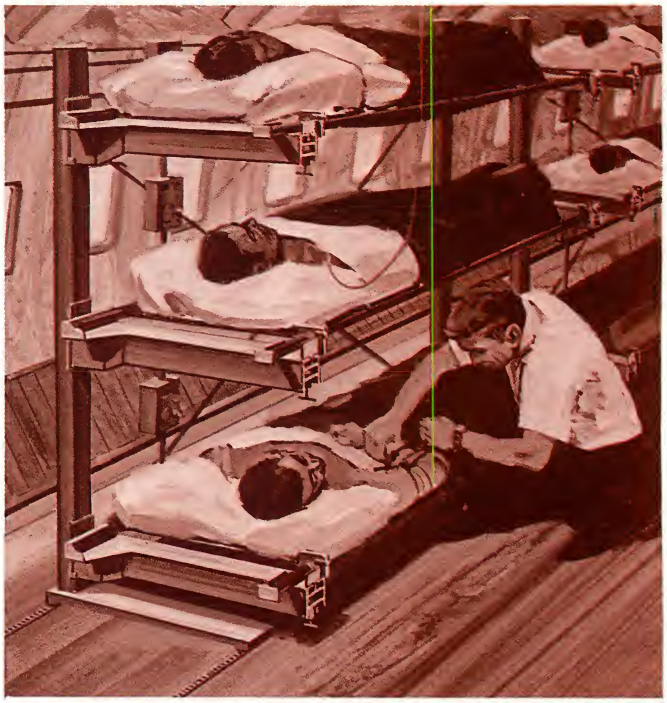
The basic characteristics of the 737-200 that make it attractive for many military missions are equally applicable for providing relief to civilian populations in the event of a natural disaster such as a flood, storm, and earthquake. Fast-response airlift of disaster relief teams with equipment and supplies to the troubled area can be followed by rapid conversion to the aeromedical configuration for evacuation of casualties.

A basic requirement of an aircraft for disaster relief missions is an ability to operate from substandard airstrips near the trouble area. It must rapidly evacuate personnel short distances for immediate medical attention as well as long distances for hospitalization and rehabilitation.

The standard 737-200 high-lift system plus the optional gravel runway kit and low-pressure tires provide for operation from these short and often unpaved airstrips.

The 737-200 is self-sufficient. No ground support equipment is required at multiple stops away from its main base.

Large Capacity for Patients

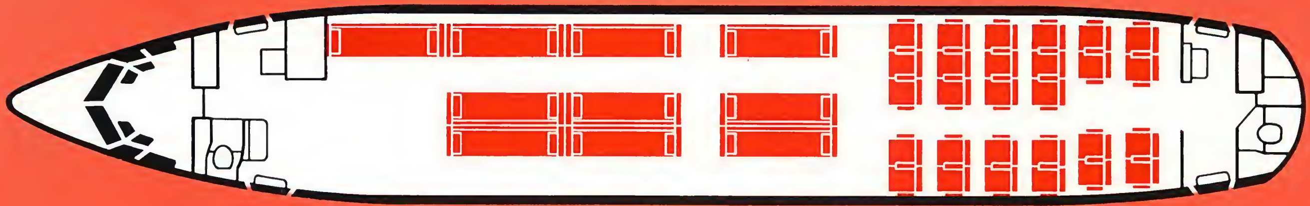


The 737-200's wide cabin ensures ease of moving patients and allows convenient access to all litter evacuees. Patient seats and litter stanchions are mounted and locked into seat tracks on the floor. This method of attachment facilitates installation and removal of interior equipment, providing the utmost flexibility in arranging the cabin.

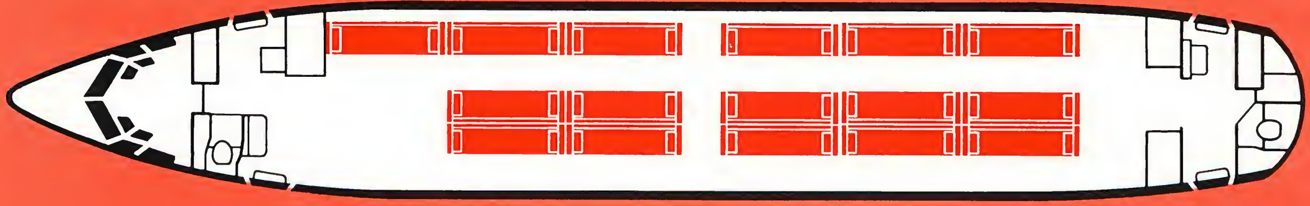
The aircraft can comfortably accommodate 30 litter patients plus 28 ambulatory patients—a total of 58 casualties. 48 patients are carried in the all-litter configuration.

A 25-inch(63.5-centimeter)-wide aisle allows access to the doors for egress. The cabin accommodates added medical equipment for more definitive patient care, while the 875 cubic feet (24.8 cubic meters) of below-deck cargo space accommodates a full patient/crew baggage load plus spare medical equipment, seats, and litter stanchions. A medical attendant's station is located in the forward cabin area as shown.

Mixed Litter-Ambulatory Configuration
30 Litters Plus 28 Seats



All-Litter Configuration
48 Litters



General Performance Characteristics






The 737-200 excels in short-field operations at both high temperatures and high altitudes. Its superior takeoff and landing capabilities have been developed through incorporation of improvements in stopping distance, high lift, and takeoff thrust.

These features increase the performance flexibility of the 737-200 in the military environment:

- Short takeoff and landing
- High-speed cruise
- Exceptional stability and control
- High-altitude and high-temperature operation
- Low-speed Category II manual and automatic approach
- Uniform deceleration and short, smooth stops
- Operation from gravel runways (optional equipment)

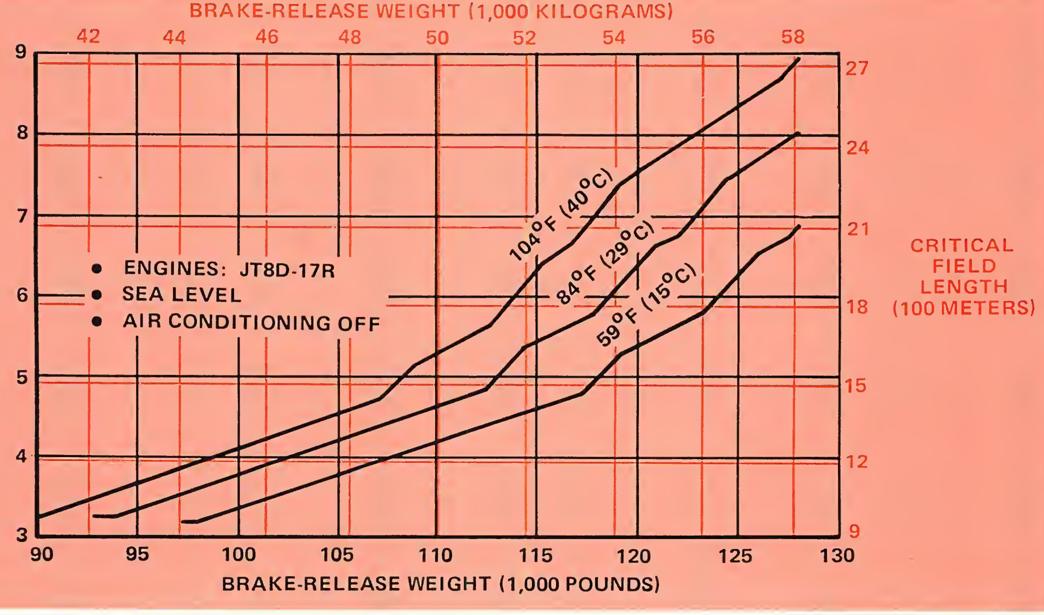
737-200 Takeoff Performance

These curves illustrate the 737-200 takeoff critical field length requirement versus brake-release gross weight at sea level and standard day temperature as well as at elevated temperatures.

Critical field length is defined as the total length of runway required to accelerate on all engines to critical engine failure speed, experience an engine failure, and either continue the takeoff to the lift-off point or stop in the remaining distance. This is termed a "balanced" field length, since the total distance to go or to stop is the same.

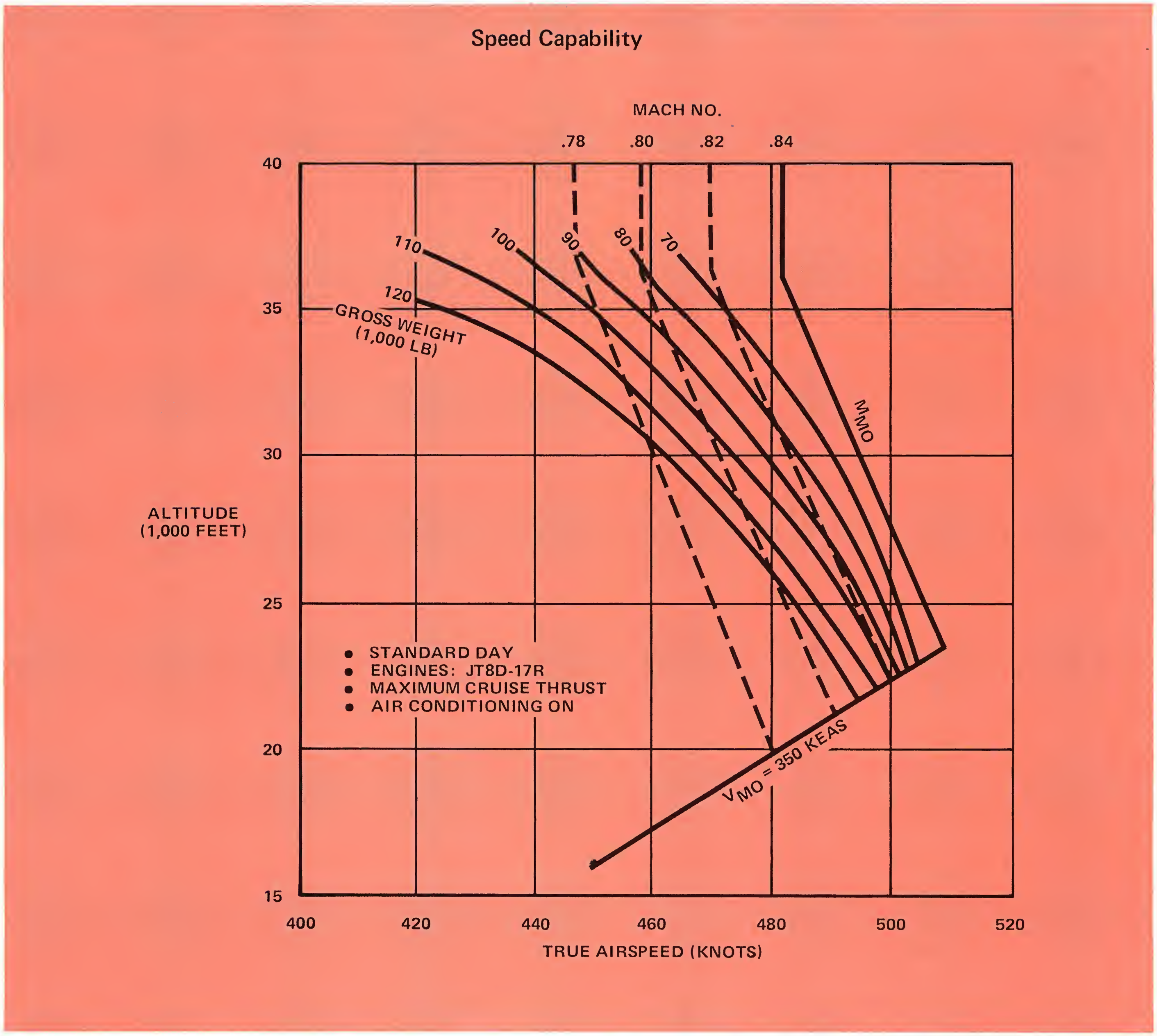
At a typical mission gross weight of 110,000 pounds (49,895 kilograms) and at standard-day (59°F or 15°C), sea-level conditions, the 737-200 has a critical field length requirement of 4,159 feet (1,268 meters).

Takeoff Performance
Critical Field Length versus Brake-Release Weight



Speed Capability

The maximum operating speed (V_{mo}) of the 737-200 is 350 knots equivalent airspeed (KEAS). The aircraft can be flown at V_{mo} from 500 feet up to approximately 23,000 feet. At higher cruise altitudes, the maximum speed capability is determined by available engine thrust.



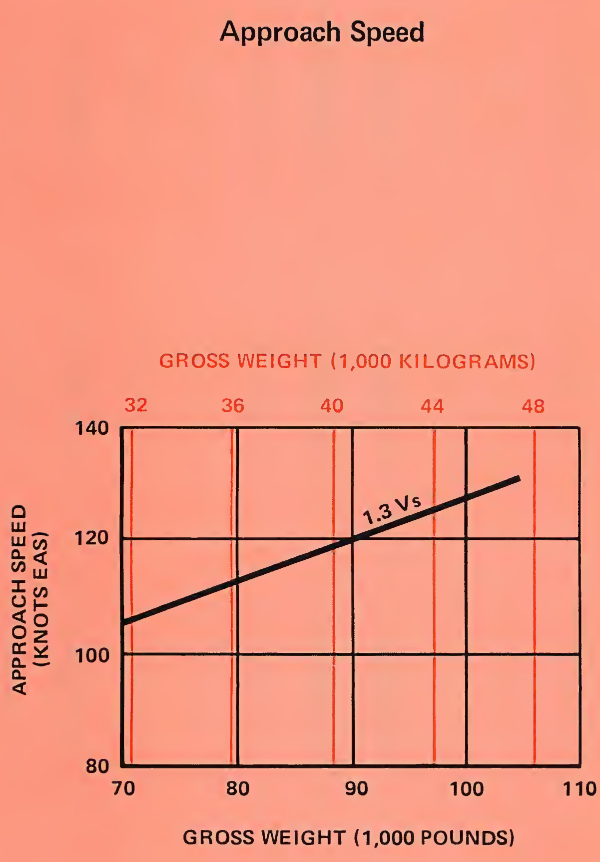
Low Approach Speeds

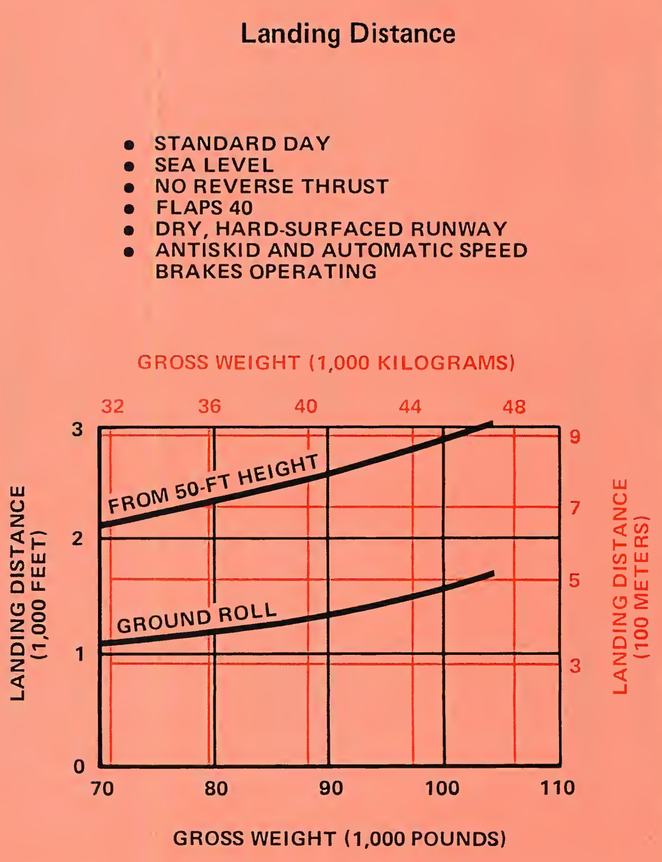
The low landing approach speeds and short-field landing capability of the 737-200 provide flexibility in airfield selection plus an additional margin of safety.

Approach speed is shown as 1.3 V_S (stall speed) with flaps at position 40. For example, at a typical mission landing weight of 85,000 pounds (38,555 kilograms), the approach speed is 117 knots.

Short Landing Distance

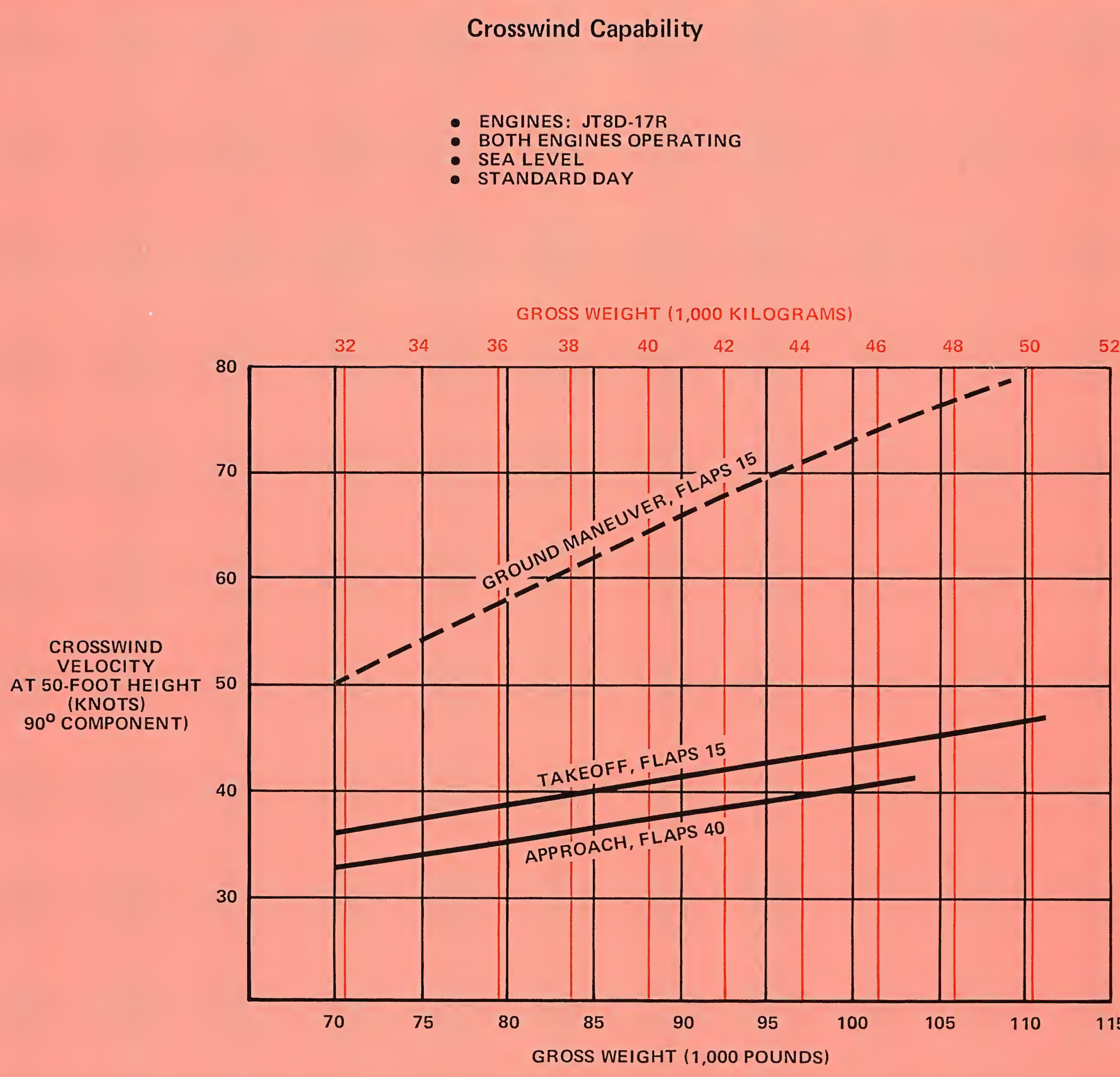
High-lift devices plus the automatic braking features allow operation into relatively short airfields. Automatic braking and improved antiskid devices ensure uniform deceleration and significantly shorten the stopping distance on wet and icy runways. At sea-level standard conditions, the landing distance over a 50-foot obstacle at a typical mission landing weight of 85,000 pounds (38,555 kilograms) is 2,500 feet.





Crosswind Capability

The 737-200 has excellent lateral control margins for crosswind operation. Curves for approach, ground maneuver, and takeoff are shown as functions of gross weight and the allowable 90-degree crosswind component. For takeoff at a typical weight of 105,000 pounds (47,627 kilograms), a 90-degree crosswind component of up to 45 knots is acceptable.



Load Classification Number (LCN)

The 737-200 load classification number at various gross weights and tire pressures is shown below for standard tires and optional low-pressure tires.

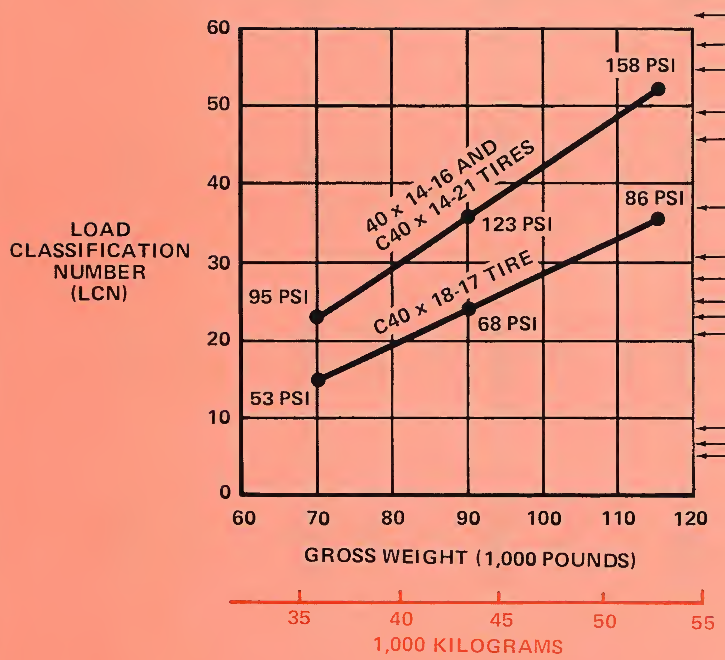
Gravel-Runway Operation

The 737-200 is certified for operation on gravel runways. Operators of this aircraft, fitted with special gravel-runway equipment, can operate in areas around the world that are inaccessible to other jet aircraft. This capability applies to operation on any field that has adequate soil bearing strength to support the operational weight of the aircraft. Gravel-runway equipment is offered as an option.

For runways where flotation characteristics are critical, optional low-pressure main gear and nose gear tires are available. Installation of low-pressure tires will permit 737-200 operations on sod, compacted sand, and thinly sealed runways.

Equipment required for gravel-runway operation is described in the DESIGN FEATURES section.

737-200 Load Classification Number
20-Inch Flexible Pavement



OTHER AIRCRAFT

AIRCRAFT	GROSS WEIGHT (1,000 LB)	TIRE PRESSURE (PSI)
DC-9-50	121.3	174
BAC-111-500	104.5	169
DC-9-40	114.3	163
DC-9-30	108.3	152
ELECTRA	113.0	138
C-130E	155.0	95
BAC-111-475	98.5	85
DC-6	97.2	99
F-28	71.0	100
CARAVELLE	110.2	155
F-28	65.0	100
YS-11	55.1	70
F-27	45.0	75
HS-748	46.5	72

Low-Weather-Minimum Capability

Standard equipment in the 737-200 meets the requirements for Category II manual and automatic approach (1,200-foot runway visual range and 100-foot ceiling).

Flight control systems afford the optimum match among pilot capabilities, aircraft handling characteristics, and the autopilot. This enables approaches and landings to be made under adverse conditions with minimum effort, maximum precision and repeatability, and uncompromised safety.

The Sperry SP-77 autopilot has been specially designed for the 737-200 to provide for automatic approaches. To provide maximum reliability, all components are derated; solid-state switching is used in signal circuits, and close tolerances are maintained through use of high-quality components and internal tolerance trim-out adjustments.

Dual Collins FD-108 flight directors ensure continuous display of lateral and pitch axis commands during manual approaches and go-arounds. Approach progress annunciators display the armed-and-engaged status of each available path mode for both flight directors and the autopilot.

The 737-200 high-lift system—consisting of triple-slotted trailing-edge flaps operating with a Fowler flap movement, leading-edge slats, and Krueger flaps—provides an exceptionally low approach speed combined with excellent approach stability.

The low approach speed results in increased time available for the pilot to acquire visual orientation, make flightpath corrections during the transition from approach to touchdown, make greater lateral alignment corrections during transition, and reduces runway length requirements. The approach stability permits smooth flight on approach with minimum throttle adjustment and attitude change, even though flap position and airspeed changes are required.

An optional automatic throttle control system is available to reduce crew workload and enable the pilots to monitor reference airspeed during adverse weather conditions.

Stability and Control

The 737-200 has exceptional stability and control. Pilots report that the aircraft is unusually light and responsive, having superior flying qualities throughout the flight envelope.

Flight test pilots are particularly enthusiastic about such handling characteristics as the lateral/directional control of the aircraft. Pilots flying the aircraft for the first time comment on its easy familiarity, a factor that substantially reduces the time required for transitional training.

The artificial-feel system for the 737-200 is designed to yield exceptionally light wheel forces. Because all feel forces are artificially induced, they can be tailored to provide an overall harmony among controls. Thoroughly effective roll control is attained using fully boosted ailerons and rapidly actuating spoilers.

Turn entry and turn coordination characteristics are excellent.

The oversize vertical stabilizer and rudder are specifically designed to yield superior engine-out control. In addition, rudder pedal forces are low; in the critical post-takeoff condition, the pilot can accept a power loss safely without exercising excessive rudder control.

Crosswind capability is the best of any Boeing aircraft. As a result of the oversize vertical stabilizer for directional control, the basic airframe Dutch-roll oscillation has a high level of damping throughout the flight regime.

Wing-mounted engines and a low horizontal tail produce outstanding stall characteristics. Full-stick-back stalls, for example, result in carefully controlled stall patterns with no pitch-up and no roll-off. Full asymmetric power stalls have also been performed, demonstrating good control throughout the stall maneuver.

The pitch control required for landing flare is low, even with a forward center of gravity.

The stability and control design features incorporated in the 737-200 rely significantly on the design experience gained from the Boeing 707 and 727 jet transports. Every effort has been made to ensure superior flight qualities and ride comfort throughout the flight envelope.

Design Features

Design Features

During 10 years of operation, the 737 has provided outstanding service to more than 100 operators on six continents. Environmental extremes vary from gravel runways in the Arctic to the high-altitude airports in South America and the rain-soaked runways of the tropics.

737 aircraft compiled more takeoffs and landings in this period than any other Boeing jet in a comparable period. Despite this demanding schedule, reliability of the 737 has been the highest of any other Boeing jet. Structural and system design features contributing to this outstanding maintainability record are described in this section.

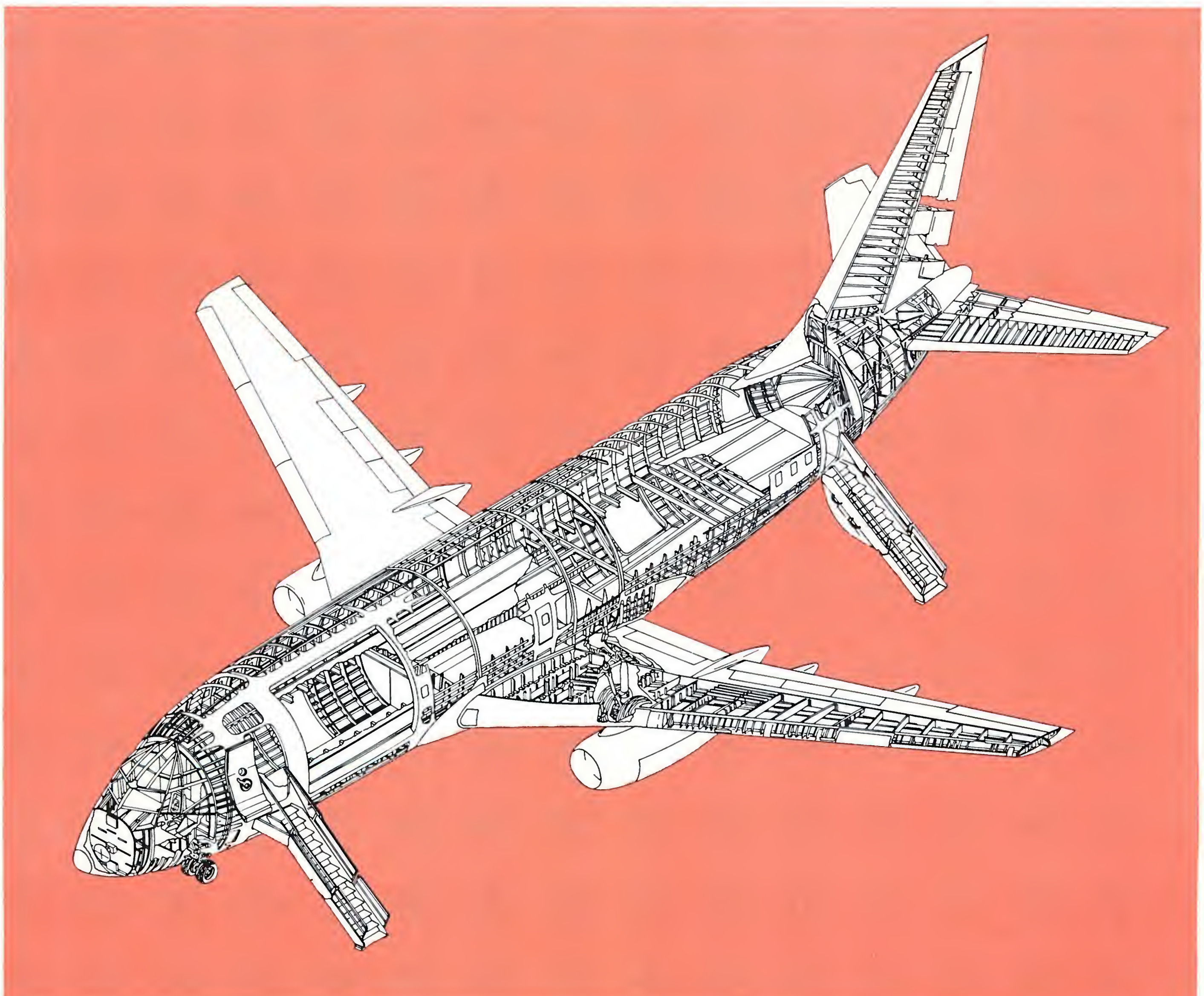
Airframe Structure

The 737-200 airframe was developed from experience gained in over 20 years of designing and developing jet transport aircraft. In addition, the experience gained from structural integrity programs on military jet aircraft—such as the B-47, B-52, and KC-135—is incorporated in the 737.

Although the aircraft is designed to FAA requirements, Boeing has applied more stringent criteria in many instances. Landing gear operating speed limits, pitching accelerations, nacelle load factors, ground gust requirements, jacking loads, landing gear design loads, cabin pressure requirements, and equipment installation load factors exceed FAA requirements.

Advanced structural development programs are conducted concurrently with the development of Boeing jet aircraft. Extensive wind tunnel and flight test programs defined 737 load and structural rigidity requirements. Full-scale fail-safe testing of the 737 design resulted in an improved pressurized cabin for additional passenger and flight safety. In addition, material and process developments allow use of efficient, high-strength materials such as titanium alloys, 270,000- to 300,000-pound-per-square-inch (18,980- to 21,090-kilogram-per-square-centimeter) heat-treated steel, and 7075-T73 aluminum forgings.

Extensive static and fatigue tests, supplemented by component tests, have ensured an efficient long-life structure. A full-scale static test and major component fatigue tests were made. These tests indicated that the 737-200 has a service life expectancy of 75,000 flights, where the damaging effect of short-haul flights is given primary consideration. Service records of predecessors of the 737-200, combined with continuous test and development programs, provided valuable 737-200 design data. These design advantages help ensure 737-200 operation in the military environment with well-qualified airframe integrity.



The primary structure is aluminum alloy skin-stringer construction. High-strength steel and forged aluminum alloy parts are used at points of locally applied high loads and load concentrations. Structural bonding is added at joints in many areas to improve the fatigue life of the basic structure. Glass-reinforced plastic construction is used for secondary structure. Airframe details are designed and materials selected for long life, fail-safeness, corrosion prevention, and minimum weight.

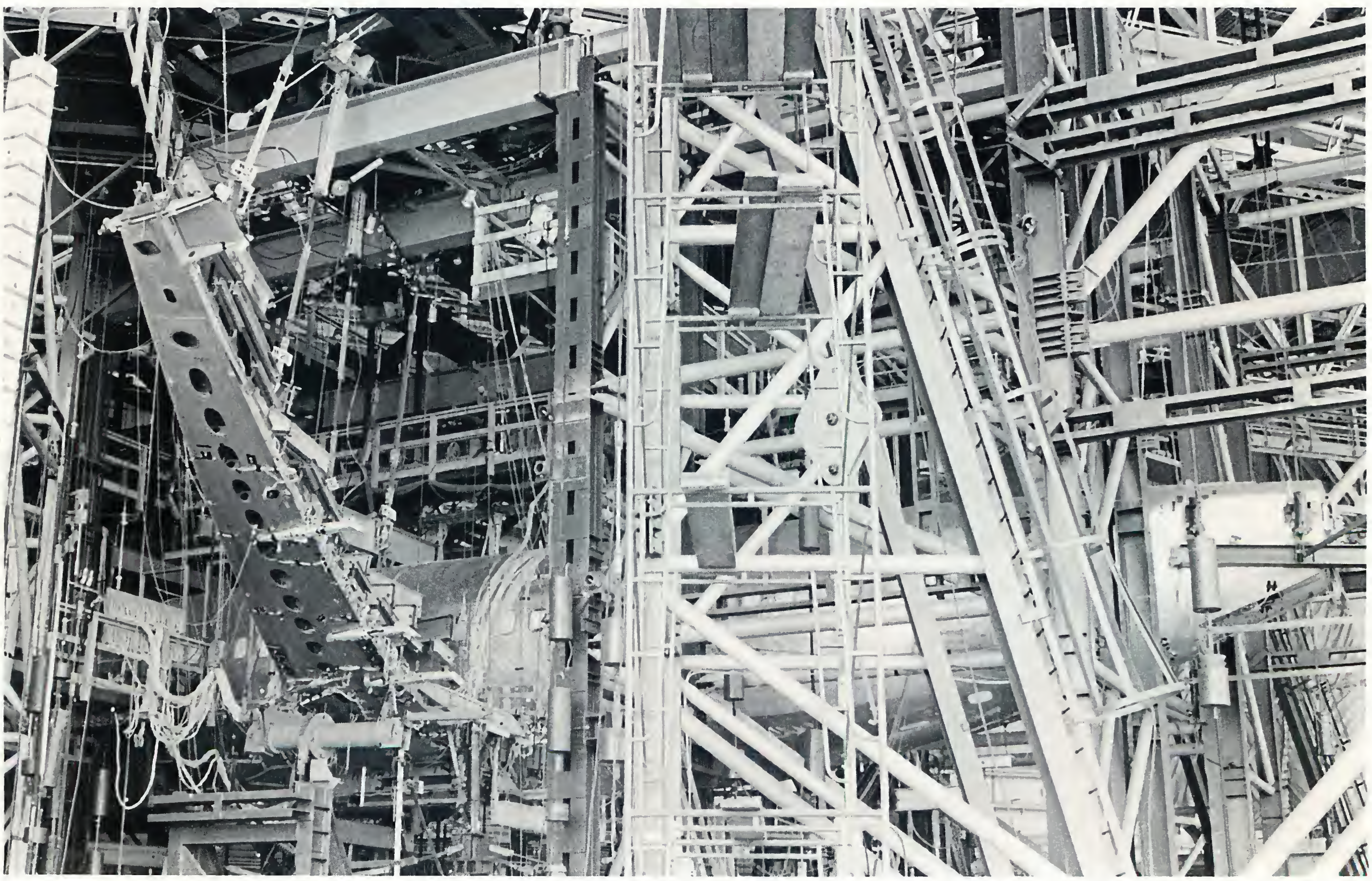
The wing is a full-cantilever, two-spar box tapering in planform and depth. The box consists of Z-section stiffener reinforced upper and lower skins. The upper surface is constructed of 7178 aluminum alloy for high strength; 2024 is used on the lower surface for fatigue resistance. Stiffened 2024 webs are used for the front and rear spars. Built-up and hydropressed ribs transmit local loads into the wing box. The left and right wing boxes and the wing center section are sealed integral fuel tanks. Built-up trailing-edge structure supports flaps, ailerons, and spoilers. The leading-edge structure supports high-lift flaps and slats. The engines are suspended directly below the wing by fittings that transmit loads into the wing box.

The fuselage is a pressure-carrying shell of semi-monocoque construction using skins, stiffeners, and frames. Bulkhead rings are used at points where load redistribution is required or load concentrations occur. The wing center section is built integrally with the body. The vertical tail is attached by bolted fittings. The adjustable stabilizer extends through openings in the side of the body. It is supported by a hinge attachment bulkhead aft of the rear spar and an actuator attached to the front spar. The cabin floor is supported by transverse beams at each frame except over the wing and wheel well where floor beams run fore and aft.

To improve fail-safe and fatigue performance, waffle grid doublers are hot-bonded to the skin throughout the pressure-carrying area. Computer analysis programs were used to determine the flow of load through the wing-body intersection region and around major cutouts in the fuselage. This provides for efficient distribution of structural material and reduction of fatigue-producing local stress concentrations.

Empennage surfaces are of spar-rib design with removable leading edges and tips. Structural Fiberglas is used extensively to produce the best corrosion and sonic fatigue resistance. The stabilizer center section is a star-shaped arrangement of beams that provides easy access, structural efficiency, and fail-safeness.

The nose and main gears are of conventional two-wheel design with high-strength-steel shock struts.



Systems

The 737-200 systems are the refined product of Boeing's more than 20 years' experience in the design and manufacture of military and commercial jet aircraft. These modern, well proven systems are key factors in achievement of the performance required in military operations:

- Operation from unpaved airfields having minimum facilities
- Short takeoff roll
- High, fast, economical cruise
- Slow, stable approach to short-field landing
- Simplicity of operation by a two-pilot crew
- Easy maintenance
- Dependability and long service life
- Double and triple systems backup for safety of flight and mission completion in all-weather operations

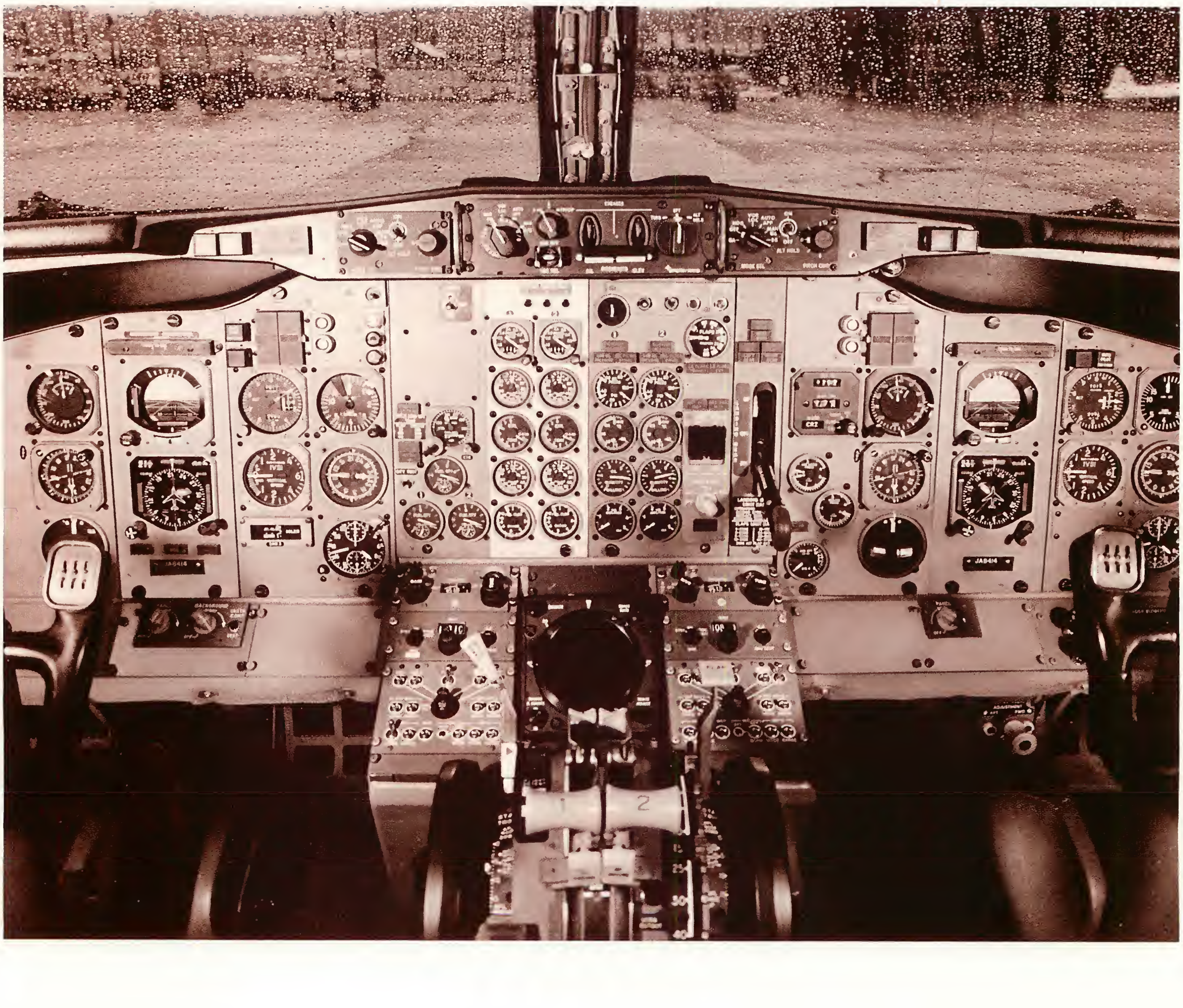
Control Cabin Features

- FAA-certified for two-pilot operation
- Low pilot workload
- Improved instrument visibility
- Increased pilot comfort
- Low-profile control column
- Category II capability
- Master caution system
- Self-monitoring systems
- Modular panels
- Improved space utilization

Simplicity keynotes the control cabin arrangement. The aircraft is designed for a crew of two pilots. Instruments and controls are readily accessible to the pilot and copilot. Extensive design toward work simplification resulted in greatly reduced pilot workloads. Comparisons with other two-pilot airplanes show that the 737-200 has the lowest workload, even when operating in congested areas under instrument flght conditions.

The 737-200 is certified for a two-pilot crew by the FAA within the U.S. and is also certified for two-man operation by many non-U.S. regulatory agencies, including the following:

Civil Aviation Authority	United Kingdom
Dept. of Transport	Canada
Dept. of Transport & Power	Ireland
Dept. of Transport	South Africa
Air Department	New Zealand
Luftfahrt Bundesamt	West Germany
Ministry of Transport	Japan
Dept. of Civil Aviation	Singapore
Government of Brazil	Brazil
Dept. of Civil Aviation	Norway
Dept. of Civil Aviation	Colombia
Dept. of Civil Aviation	Argentina



Crew Seats

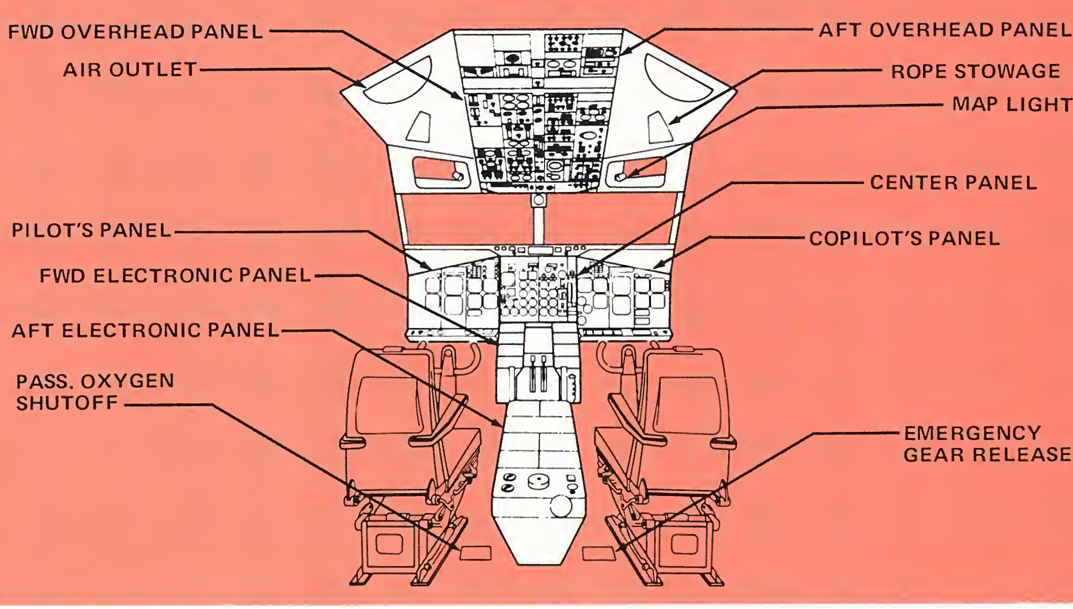
A new crew seat was designed for the 737-200 to improve comfort level, reduce vibration, and provide greater accessibility. The new seat reclines and is adjustable in vertical and horizontal directions. It features an additional adjustment for thigh pressure. Seat attachment to the floor is direct, eliminating use of seat tracks and attendant problems of seat play. Horizontal motion is accomplished by a parallelogram motion around fixed points. This arrangement minimizes vibration and effects of turbulence. Arm rests are adjustable and rotate behind the seats for easy ingress and egress.

Pilots' seats are equipped with automatic, dual-strap, inertia reels. A stowable observer's seat is installed forward of the cockpit door, and space is provided for an optional second observer's seat behind the pilot's seat.

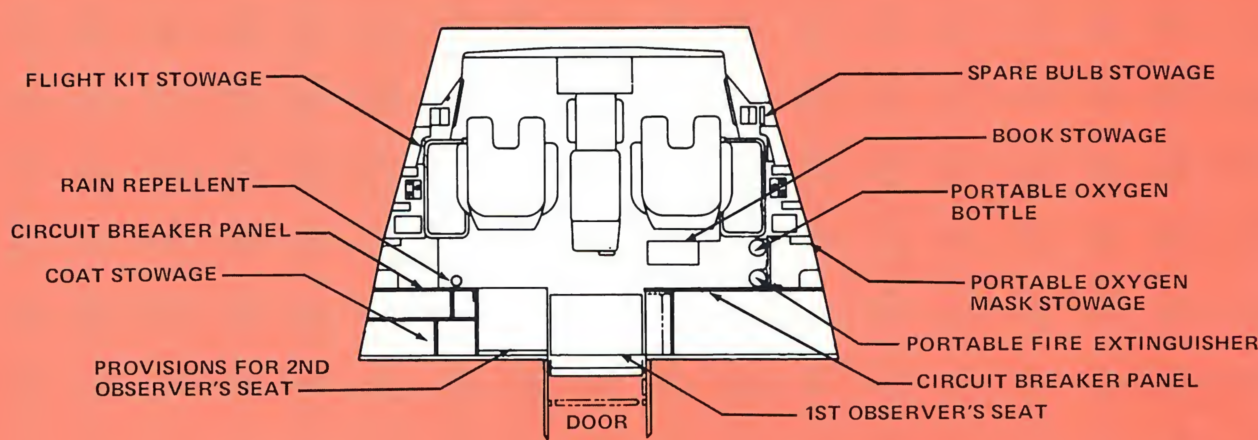
Control Column

A low-profile control wheel and column are installed in the 737-200. The control wheel permits full functional operation without visual obstruction of instruments on the lower part of the instrument panel. In addition to housing thumb-operated switches for primary stabilizer trim, autopilot disconnect, and oxygen mask microphone or boom microphone, the 737-200 control wheel features a chart holder, a checklist, and a digital counter, which may be used for such purposes as an altitude clearance reminder.

Control Cabin Arrangement



Control Cabin Plan View



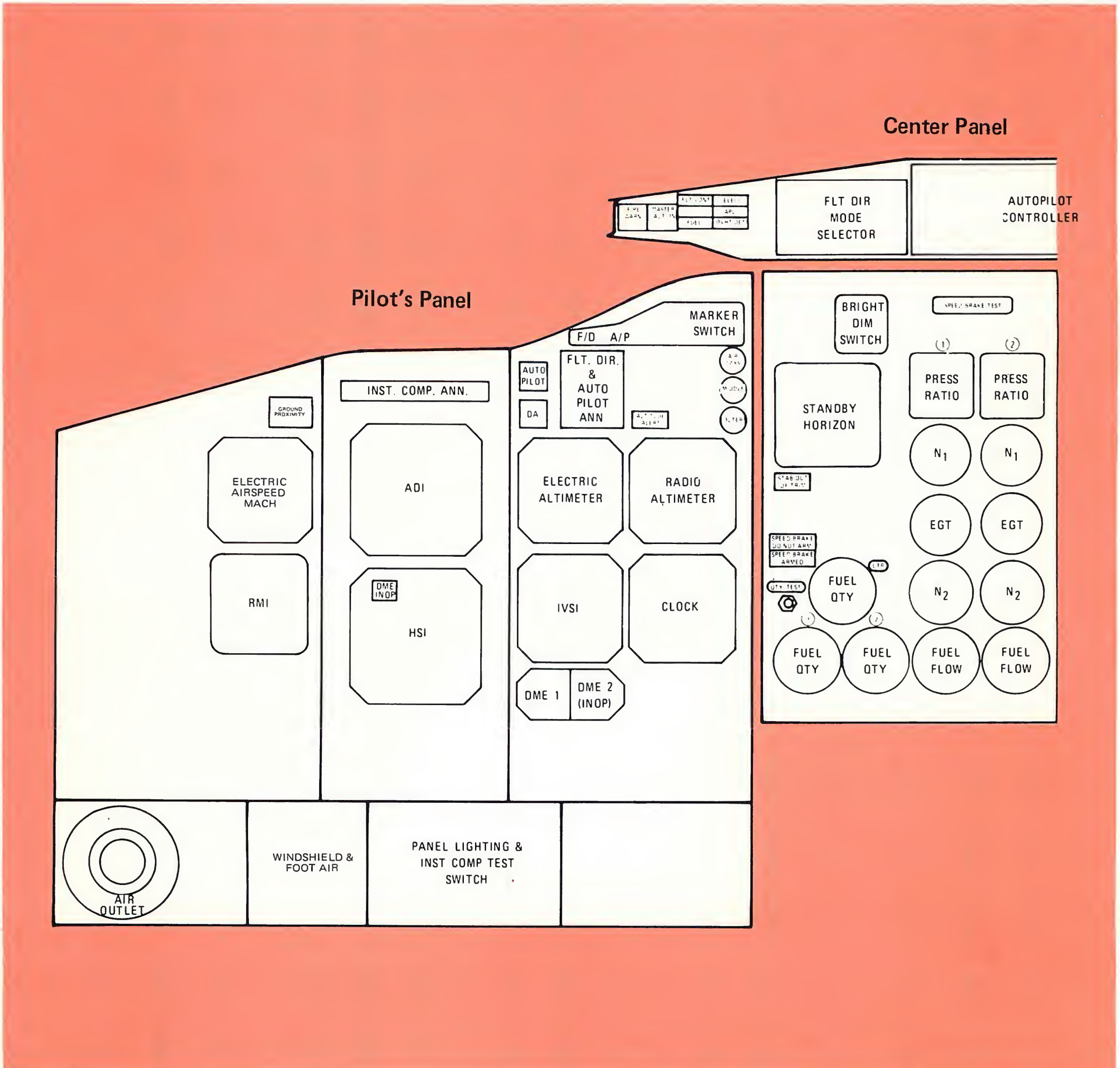
Instrument Panel

Instrument panels are so located that all controls required for flight are operable by either pilot. Extensive crew workload studies were made to obtain optimum grouping of controls and indicators.

The arrangement of the pilot's and copilot's basic flight instruments reduces pilot head/eye motion while still providing ample visibility. The arrangement of flight instruments for the pilot and copilot panels are identical. An instrument comparator system warns of significant differences in signal inputs to pilots' instruments for heading (HDG), pitch, roll, glide-slope (GS), and localizer (LOC). The approach progress display provides side-by-side mode annunciation for flight director and autopilot VOR/LOC, GS, and go-around for flight director only. The TAT/EPR and hydraulic indicators are located on the left side of the copilot panel.

The center instrument panel contains engine instruments, fuel and gear position indicators, flap annunciators, performance data computer annunciator, battery-powered standby horizon indicator, and anti-skid and auto-brake controls.

The glare shield accommodates the fire warning lights, master caution system, flight director mode selectors, and autopilot mode selector.

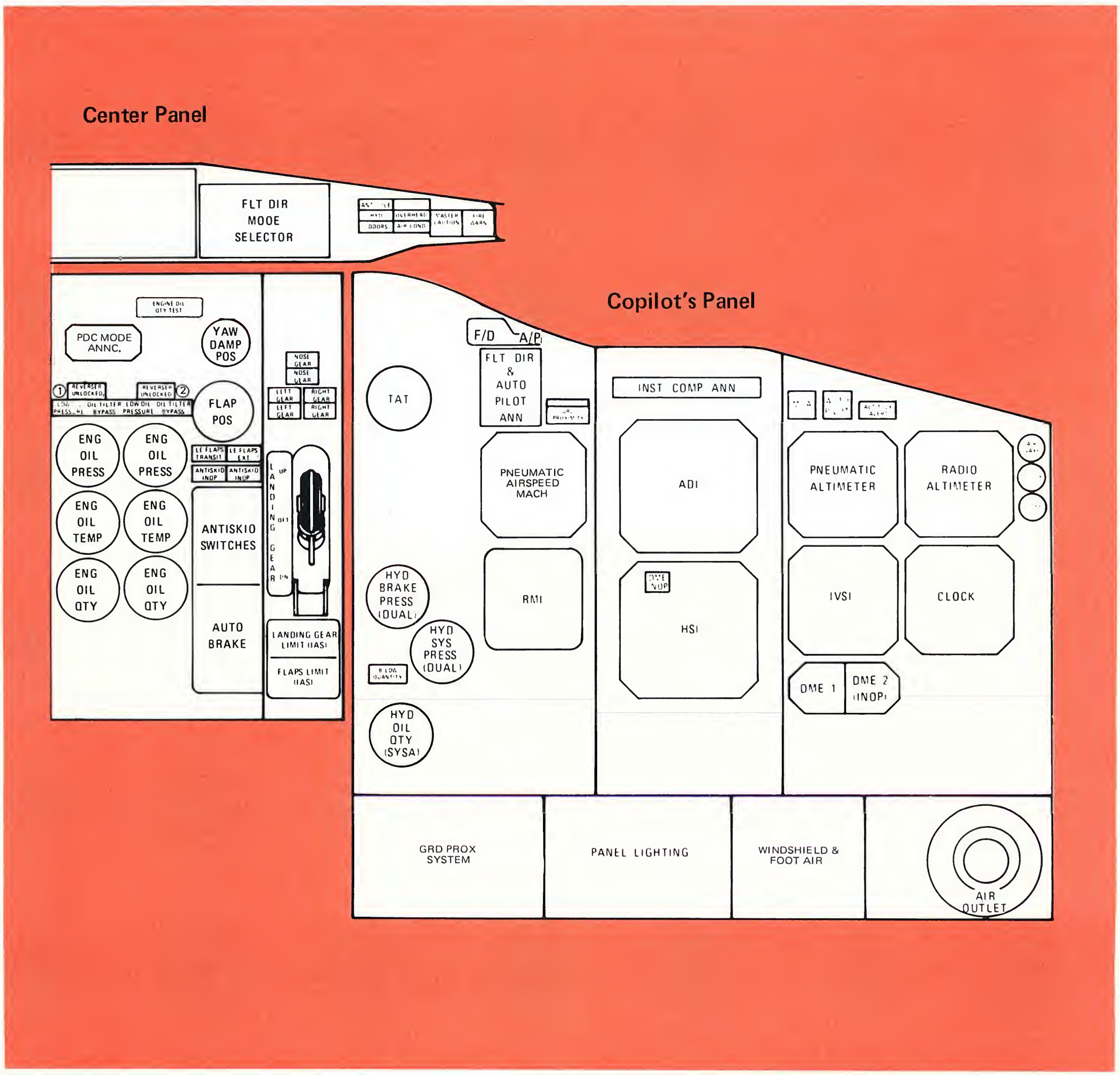


Master Caution System

Master caution lights and system identification annunciators are on both outboard ends of the glare shield. Both the master caution and annunciator lights illuminate whenever a caution condition is indicated on system modules outside the peripheral vision of the pilots. The master caution and annunciator lights may be reset to arm for other possible malfunctions; however, the individual system caution light remains on until the problem is corrected.

Any time the pilot wishes to verify whether a malfunction still exists, the system annunciator light lens may be depressed. Depressing either system annunciator lens will illuminate all the system lights on both annunciators and both master caution lights, and, upon release, the malfunctioning system light will remain illuminated.

The ability to check operation of all master caution lights and verify previous malfunctions streamlines checklist procedures. This system capability saves time during takeoff and landing.



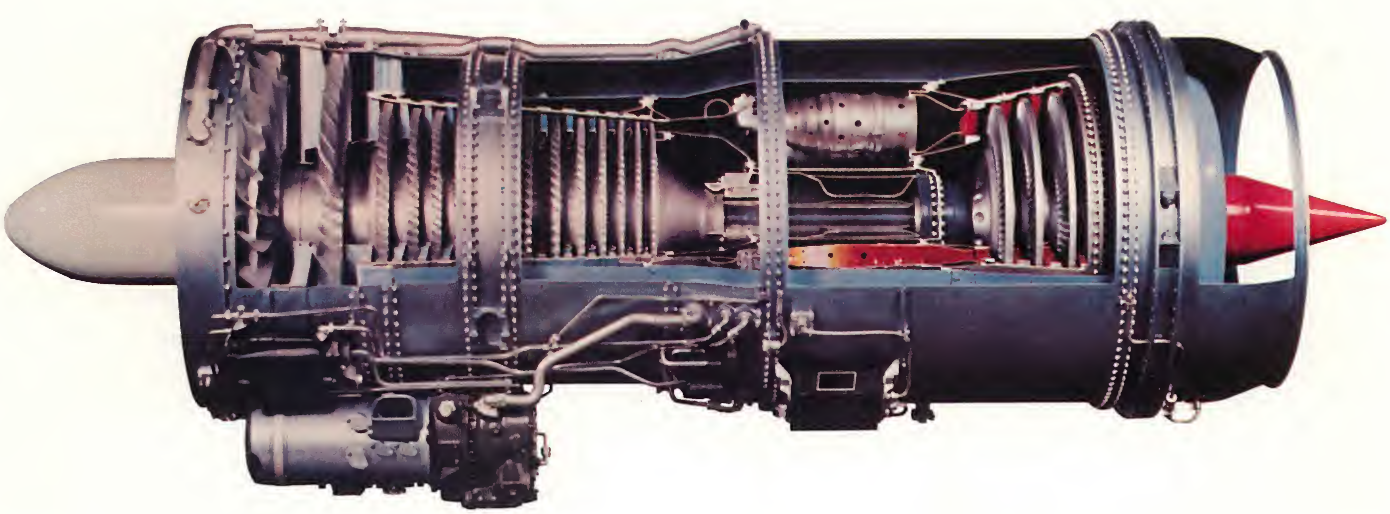
Powerplant Features

- Pratt & Whitney JT8D wing-mounted engines
- Eye-level system accessibility from the ground
- Fire and overheat detection
- Left and right quick-engine-change assemblies essentially interchangeable
- High-performance thrust reversers
- Improved constant-speed drive and long-life generators
- Short engine change time
- Aft body-mounted auxiliary power unit (APU) operable in flight
- Simplified fuel system

The Pratt & Whitney JT8D engine was first certified in 1963. Since then, it has been used as the sole powerplant on the Boeing 727 and 737, as well as on competitor aircraft. The engine has evolved in performance capability to help the 727 and 737 remain leaders in their respective markets.

The 737-200 described in this brochure is powered by two JT8D-17R engines flat rated at 16,400 pounds (7,439 kilograms) sea-level static takeoff thrust to 77°F (25°C). Automatic performance reserve (APR) provides an automatic thrust increase to 17,400 pounds (7,893 kilograms) on the operable engine in the unlikely event of engine failure during takeoff. This thrust increase is completely automatic; no pilot adjustment of thrust levers is required.

Bypass air is ducted into the outer case of the engine, providing a relatively-low-temperature environment for the engine accessory section. Fan air is mixed with the hot turbine discharge gases forward of the thrust reverser.



JT8D-17R Characteristics

Takeoff (Sea-Level Static Conditions)		
Maximum Thrust*	17,400 Lb	7,893 Kg
Alternate Thrust	16,400 Lb	7,439 Kg
Flat Rating	77°F	25°C
Bypass Ratio	0.97	
Maximum Cruise (Std Day, 30,000 Ft, M 0.80)		
Net Thrust	5,140 Lb	2,332 Kg
Specific Fuel Consumption	0.832 Lb/Hr/Lb	
Weight	3,415 Lb	1,549 Kg

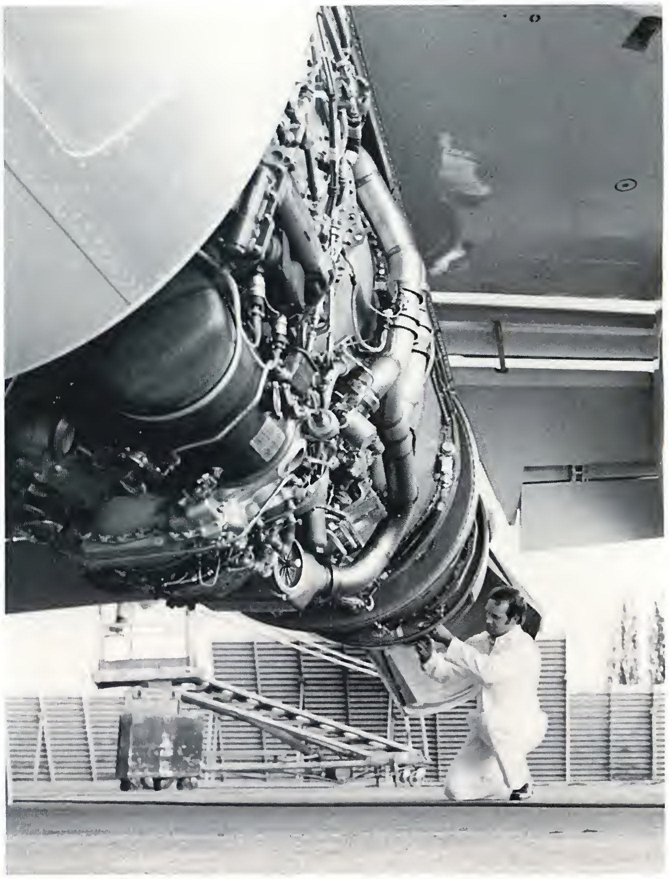
*With APR activated

Engine Installation

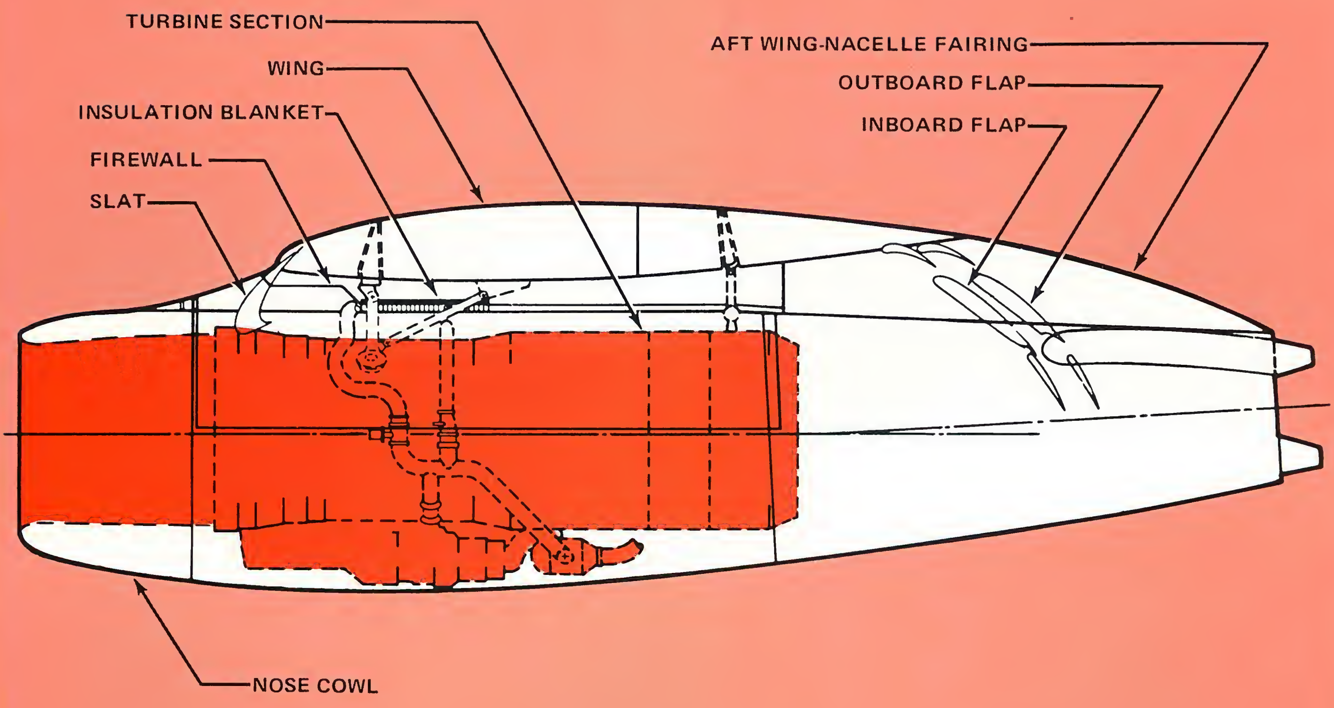
The engines are mounted by cone bolts at three points: two in the front and one in the rear. The front mounts take all thrust loads, plus vertical and side loads; the rear mount takes vertical and side loads only.

Engine Buildup

Engine buildup is identical for the left- and right-hand positions except for the nose cowl and thrust reverser tailpipe. Engine accessories—plumbing, wiring, ducting, and firewall-attached components—for the two engines are identical. Elapsed time for engine buildup is 8 hours (approximately 38 man-hours).



JT8D Engine Installation



Engine Placement

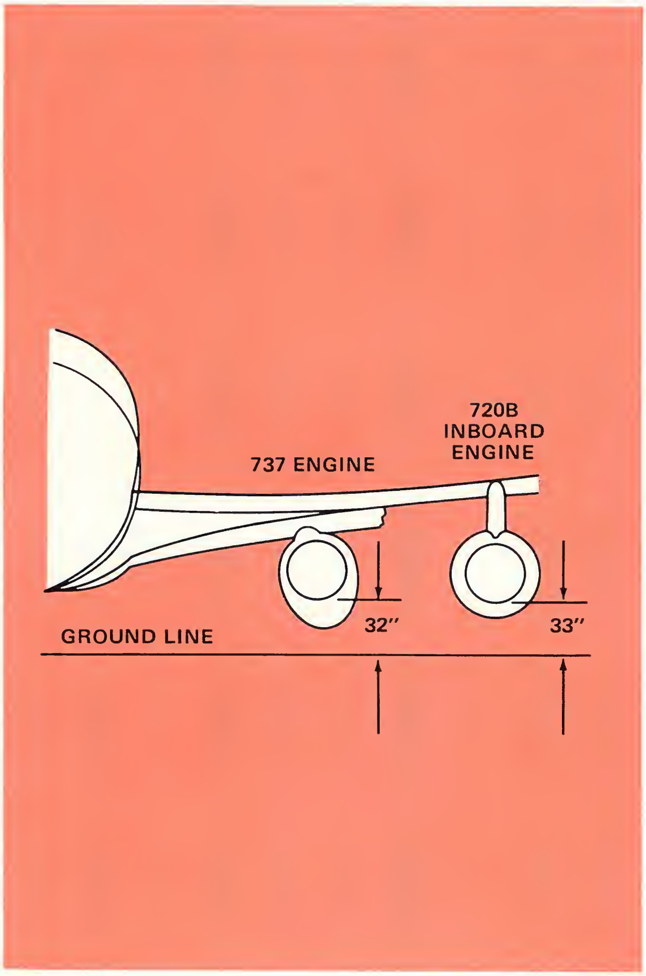
During an extensive engineering evaluation of possible engine locations on the 737-200, it was determined that wing-mounted engines offered advantages that aft body-mounted engines could not. These include increased fuselage interior floor space and volume, better structural efficiency, improved engine accessibility, and weight-and-balance flexibility for aircraft loading.

The height of the engine inlet on the 737-200 is approximately the same as the inboard engines on the 720B, as shown below.

The 737-200 wing-mounted engine's foreign object damage (FOD) rates per flight cycle are comparable to similarly sized twinjets with tail-mounted engines.

Data from three operators over an 18-month period of sub-arctic operations, including gravel runway operation with the gravel deflector/vortex dissipator kit installed, indicate FOD rates are lower than average 737 fleet FOD rates.

The 737-200 does not require chined tires or spray deflectors, because its engines are located well outboard of the water and slush spray pattern generated by the nose gear. The particular spray patterns shown were demonstrated by tests with standard tires at the worst-speed condition (approximately 40 knots).



Thrust Reverser

Both engines are equipped with a target-type, high-performance thrust reverser that provides maximum retarding force during landing roll. Reverser effectiveness has been demonstrated by stopping the aircraft within the required FAR dry field length without the use of brakes. The deflector doors are oriented to minimize engine ingestion of exhaust gases or runway debris and to maximize thrust levels during the reversing operation.

Reversers are controlled by thrust levers on the control stand. Throttles must be at idle setting before thrust reversers can be actuated.

Engine Starting

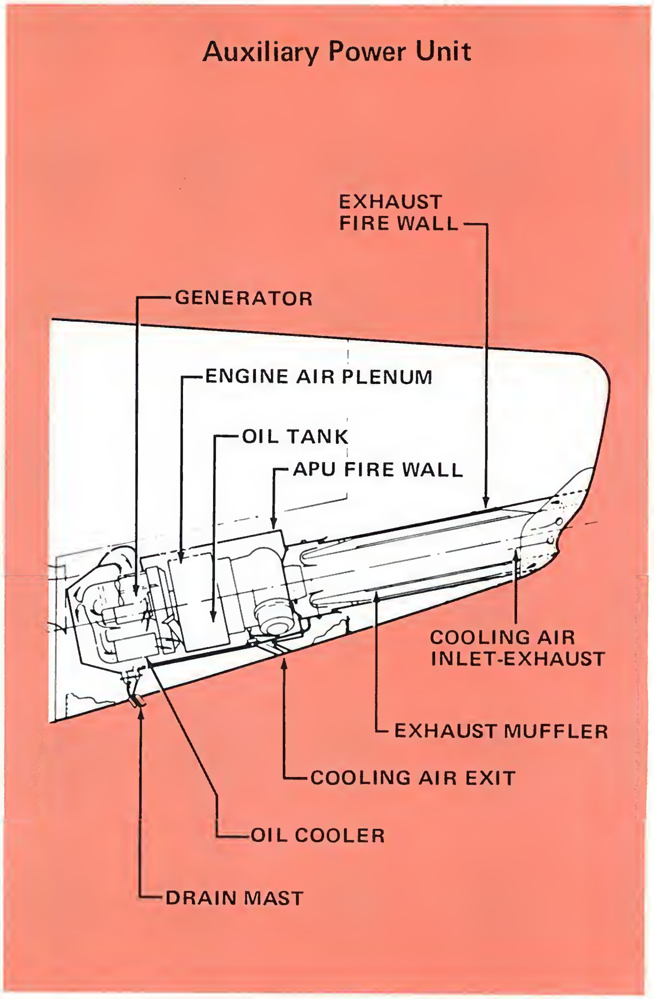
There are three basic methods available for engine starting:

- Ground Start—A pneumatic ground cart may be utilized to provide air via a ground connection to the engine starter.
- Cross-Bleed Start—Air from a running engine is supplied to the engine starter via the air conditioning supply pneumatic ducts.
- APU Start—The APU provides air via the pneumatic system to the engine starter. This is the normal starting method.

Auxiliary Power Unit

A gas turbine auxiliary power unit (APU) is located in the aft end of the fuselage behind the pressure bulkhead and under the horizontal stabilizer. The APU may be operated in flight up to an altitude of 35,000 feet (10,668 meters). APU exhaust noise is minimized for passengers and ground crew due to the APU location: remote from the cabin and ground service points. In addition, the APU exhaust tailpipe is acoustically treated for noise reduction.

The APU can furnish electrical power either in flight or on the ground. A 40-kva generator, identical to the engine generators, is mounted on the accessory drive pad of the APU. Bleed air from the APU is routed to the air conditioning system and may be used to operate either of the two air conditioning packs. Pneumatic ducts also route APU bleed air to the engine starters. Normal aircraft ground servicing, including refueling, may be accomplished with the APU operating.



Fuel System Features

- Single-point underwing fueling station
- No jettison system required
- Density compensated gaging
- Boost pump replacement without defueling
- 15-minute fueling time
- Gravity fuel flow

Rapid single-point fueling at a rate of 300 gallons (1,136 liters) per minute allows operators to fuel the 737-200 in 15 minutes or less. An illuminated fueling station is located in the right-hand wing leading edge, outboard of the engine nacelle, and contains a fueling receptacle that mates with an MS 29520 nozzle. Individual tank control is provided by shutoff valves that permit partial or selective filling. These valves may be operated by external, APU, or battery power. The installation of all fueling valves at the fueling station outside the tanks ensures ease of accessibility.

Overwing refueling of the tanks can be accomplished through a port on the upper surface of each wing. Overwing or pressure fueling may be accomplished with the APU operating.

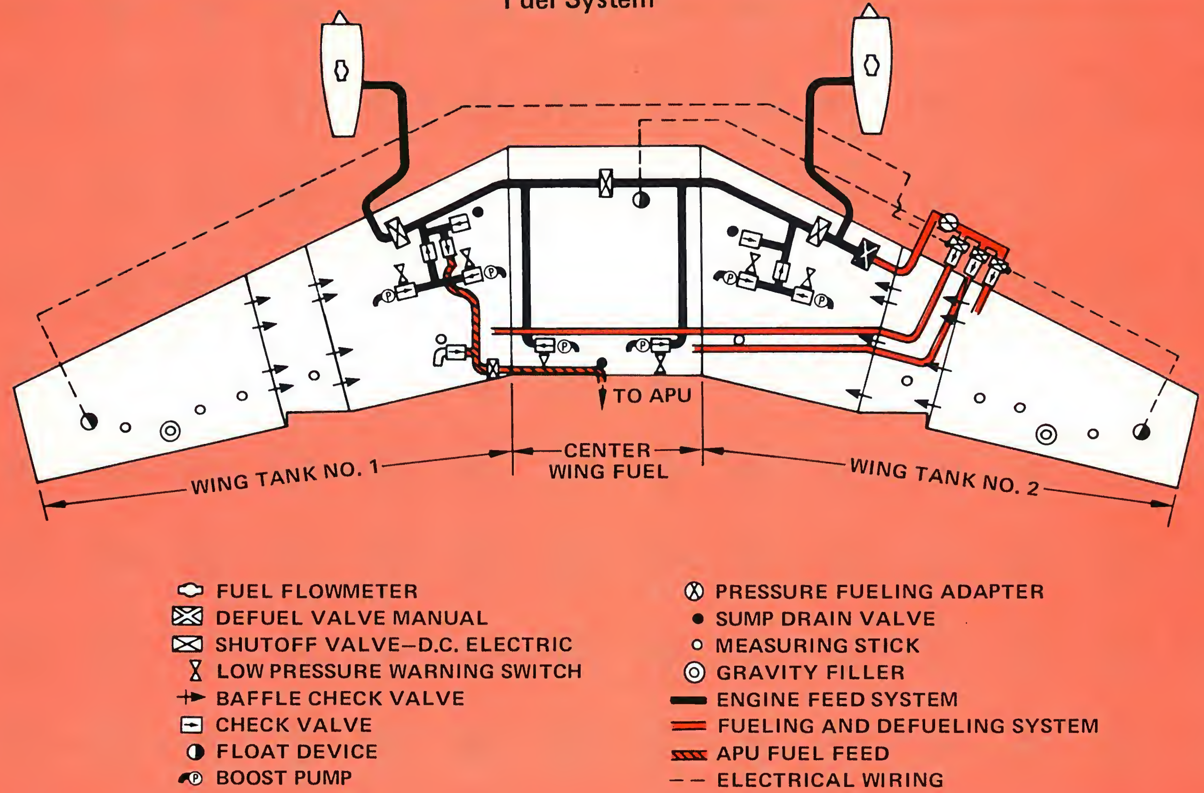
The wing-mounted engines of the 737-200 are supplied with fuel directly from a tank-to-engine system. Fuel also may be delivered to either engine from the opposite tank through a crossfeed manifold. The main fuel tanks are integral with the wing structure, located within the wing torque box outboard of the fuselage. An integral tank is located in the wing center section.

Fuel tank construction includes baffle ribs to keep fuel available to boost pump inlets during steep climb or high bank angles. Fuel valves are installed directly on the tank wall, and fuel lines are routed inside the fuel tanks for maximum safety.

Each of the three fuel tanks contains two electrically powered boost pumps that supply the engine fuel feed system and the defueling system. Since the engines are located beneath the wing, operation can be maintained with gravity fuel feed only. Suction-operated bypass valves, located in wing tanks No. 1 and No. 2, permit gravity fuel feed to the engines. Suction is obtained from engine-driven fuel pumps. The center wing tank and optional body tanks contain "override" boost pumps.

Defueling through the fueling nozzle, at approximately 50 gallons (189 liters) per minute per tank, is possible by suction or boost pumps and by using the crossfeed manifold valve. No in-flight fuel transfer or jettison system is required.

Fuel System



Hydraulic System Features

- Simple, functionally independent 3,000-psi subsystems
  - System A—Two engine-driven pumps
  - System B—Two electric motor-driven pumps
  - Standby system—One electric motor-driven pump
- In-place subsystem testing
- High filtration
- Minimum system joints
- Modular components

The hydraulic system is comprised of three functionally independent 3,000-pound-per-square-inch (211-kilogram-per-square-centimeter) systems, designated A, B, and Standby.

System A is powered by two engine-driven pumps. It provides hydraulic power for flight controls, ground spoilers, landing gear retraction, flaps, leading-edge flaps and slats, nose gear steering, inboard brakes, and thrust reversers.

System B is powered by two electric motor-driven pumps supplying power to flight controls and outboard brakes. These pumps also may be used to supply ground power to system A for servicing.

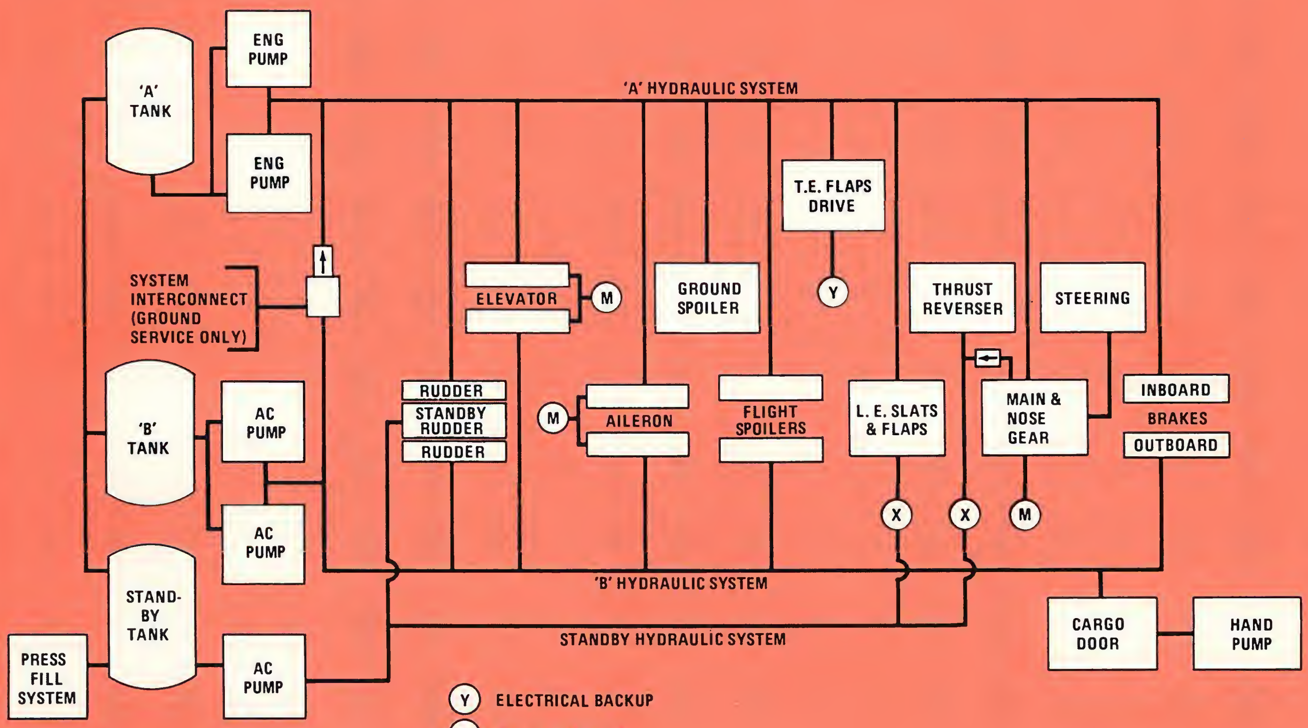
The Standby system, powered by a separate electric motor-driven pump, provides backup power to the rudder control system and is also used for alternate extension of the leading-edge flaps and slats. In addition, the Standby system provides backup power for thrust reverser operation.

Shutoff capability is provided for A- and B-powered flight controls to permit isolation of these subsystems for training, malfunctions, or servicing.

Single-point filling of all hydraulic tanks is by a pressure fill system using a standard ground cart or hand pump.

A hydraulic system control module is installed on the pilots' overhead panel and includes hydraulic pump switches, low-pressure warning lights, electric motor pump switches, electric motor pump overheat warning lights, and a valve control switch for systems A and B interconnect. Hydraulic system switches and warning indicators for the flight controls are also located on the overhead panel within easy reach of either pilot.

Hydraulic System

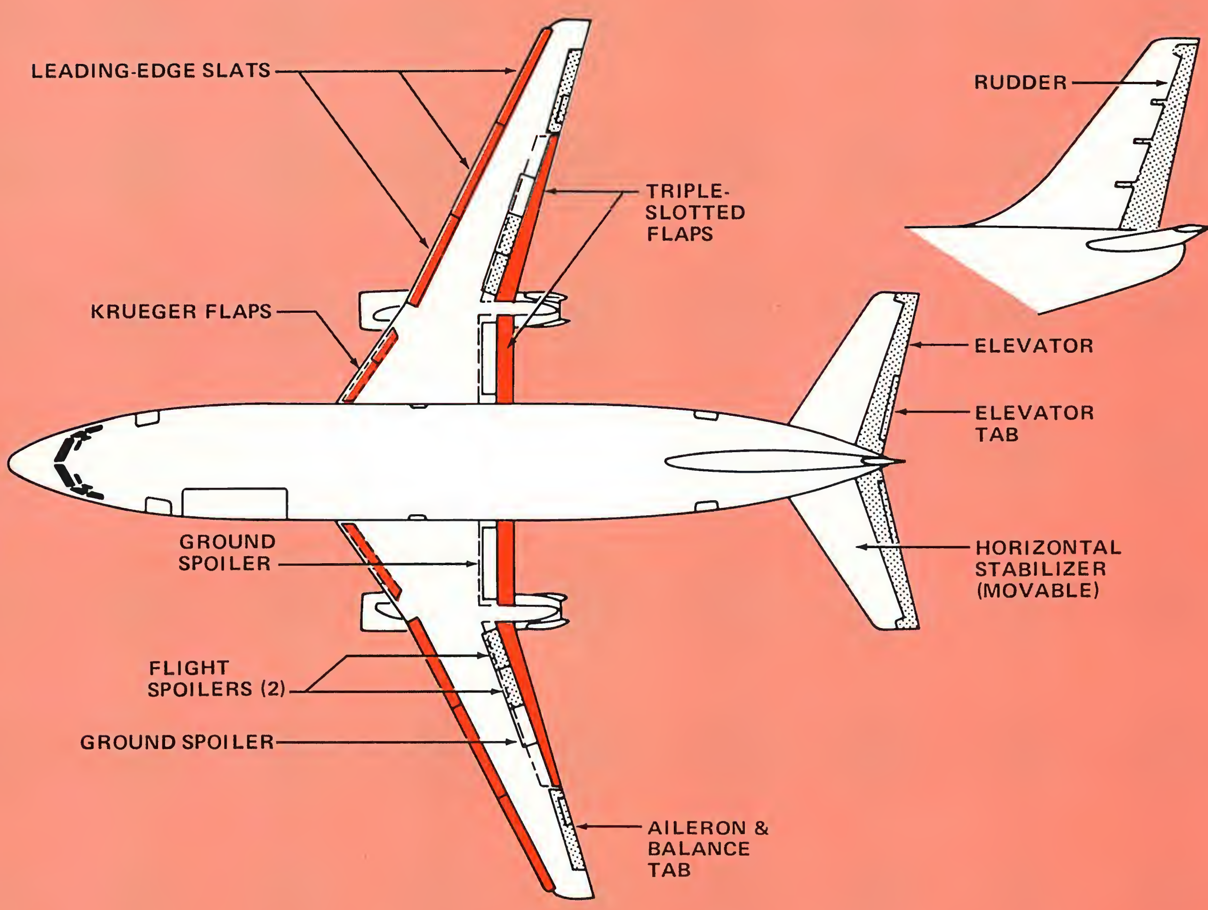


Flight Control Features

- Efficient high-lift devices
- Dual hydraulic-powered aileron and elevator with positive manual reversion
- Dual hydraulic-powered rudder with separate hydraulic standby
- Improved, simplified dual hydraulic power packages
- Electric stabilizer trim with manual backup
- Simplified control systems with reduced number of parts
- Tailored control forces
- Simplified hydraulic flap drive system with electric backup
- Advanced autopilot with control wheel steering
- Optional automatic throttle control

The 737-200 features the latest flight control systems. Experience from the long line of Boeing military and commercial aircraft has resulted in the incorporation of the most advanced control systems with unmatched simplicity, reliability, and maintainability. Wing-mounted flight control surfaces and high-lift devices offer excellent flight characteristics and short-field performance. Yaw is controlled by a single conventional rudder without tabs. All 737-200 primary flight controls are fully powered by two hydraulic systems. Simple mechanical reversion backs up the primary hydraulic power systems except for the rudder, which can be operated with a third hydraulic power source and separate actuator.

Flight Control Surfaces



High-Lift Devices

The 737-200 wing high-lift system provides outstanding takeoff and landing performance. These high-lift devices consist of leading-edge slats, Krueger-type flaps, and triple-slotted trailing-edge flaps. The leading-edge slats have three positions for optimum performance in cruise, takeoff, and landing. The trailing-edge flaps have a Fowler-type action that provides a large wing area, high lift and low drag for takeoff, and high lift and high drag for landing. Both leading- and trailing-edge devices are nested into the wing for high speed and low drag in the cruise condition.

The leading-edge devices are extended hydraulically by either system A or standby systems and are sequenced by trailing-edge flap positions. The flight crew merely selects a trailing-edge flap setting and the leading-edge devices automatically travel to the correct position.

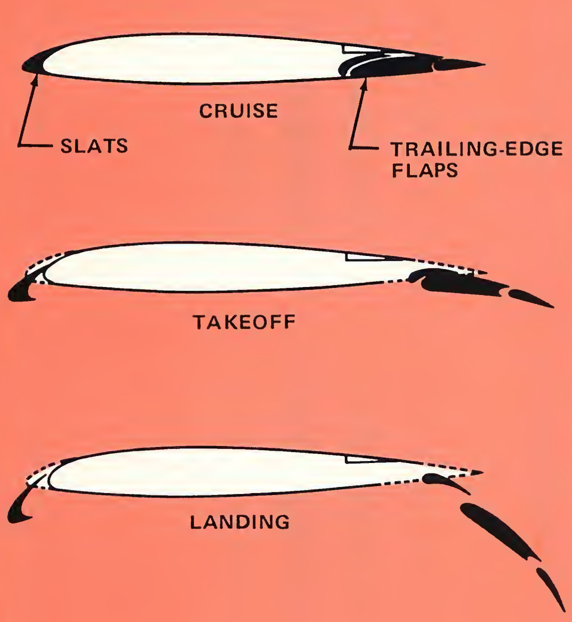
Two trailing-edge flaps are on each wing, one inboard and one outboard of the engine nacelles. Each flap section is driven by two ball-bearing drive screws connected to a single torque tube drive. Normal operation is by a single hydraulic motor, with an electric motor serving as a backup method of operation. Automatic shutoff is provided in the event of flap asymmetry. The trailing-edge flaps consist of three segments: the fore flap, mid flap, and aft flap. Initial flap motion is rearward for a maximum increase in wing area. Flap segments are mechanically interconnected to open slots between the segments. Extension of the flaps results in an effective wing area increase of approximately 17% for takeoff and 22% for landing.

Lateral Control and Speed Brakes

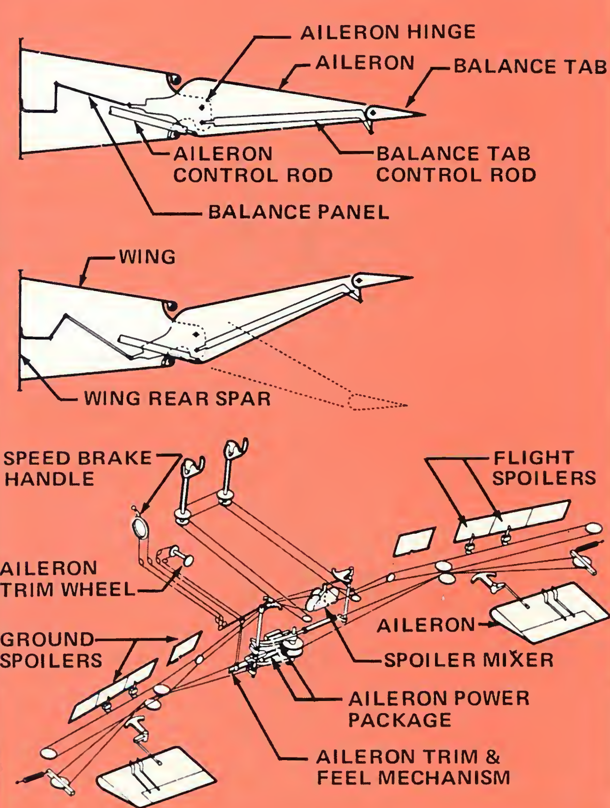
Lateral control is provided by one aileron and two flight spoilers on each wing. The flight spoilers also act as efficient speed brakes that may be extended at any airspeed without affecting lateral control. Ground spoilers are also located on the wing to provide additional lift-dumping and deceleration after touchdown.

Flight and ground spoilers are hydraulically powered and operated by individual actuators. The flight spoilers are programmed through a differential mechanism for tailored response. The ailerons are powered by two independent hydraulic power packages connected to hydraulic systems A or B. Either package is capable of providing full power control. With hydraulic power off, lateral control is maintained by automatic reversion to manual control. Manual reversion control forces are minimized by aileron balance tabs and balance panels.

High-Lift Devices



Lateral Control and Speed Brakes



Longitudinal Control

The elevators are powered directly by two independent hydraulic power packages identical to the lateral control power packages. One actuator is connected to system A and one to system B. Either power package can furnish full pitch control through a torque tube that connects the two elevators.

Pilot input to the power packages is through a dual cable system. A feel system provides positive feel proportional to airspeed, center of gravity, and gross weight. An elevator feel computer senses stabilizer position and dynamic pressure "Q" to prevent large changes in stick forces caused by changes in center of gravity.

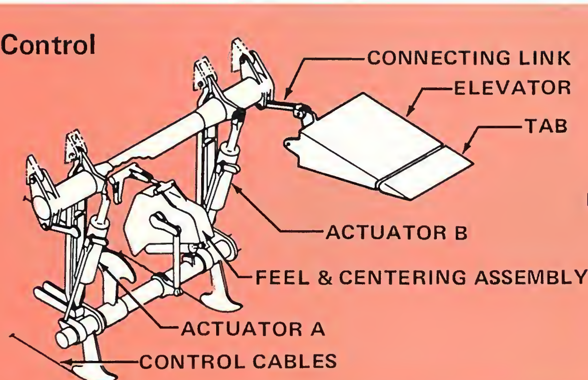
Tabs are hydraulically locked to the elevators during normal powered operations. With hydraulic power off, these tabs revert automatically to balance tabs to reduce manual control forces.

The 737-200 incorporates a stall warning system which provides the pilot with a positive indication of an impending stall. An electrically operated motor attached to the pilot's control column shakes the column when the aircraft approaches stall speed.

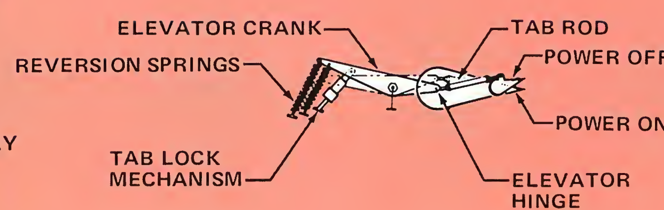
Mach trim compensation for the 737-200 is via elevator displacement using an electric servo without clutches. Mach trim operates with autopilot on or off and occurs automatically at the appropriate mach number. Movement of the control column is so subtle that the crew is unaware of compensation occurring.

Failure is annunciated by a light on the overhead panel and the master caution light. Since the system does not require synchronization, circuitry is very simple.

Elevator Control



Power Mode Mechanism

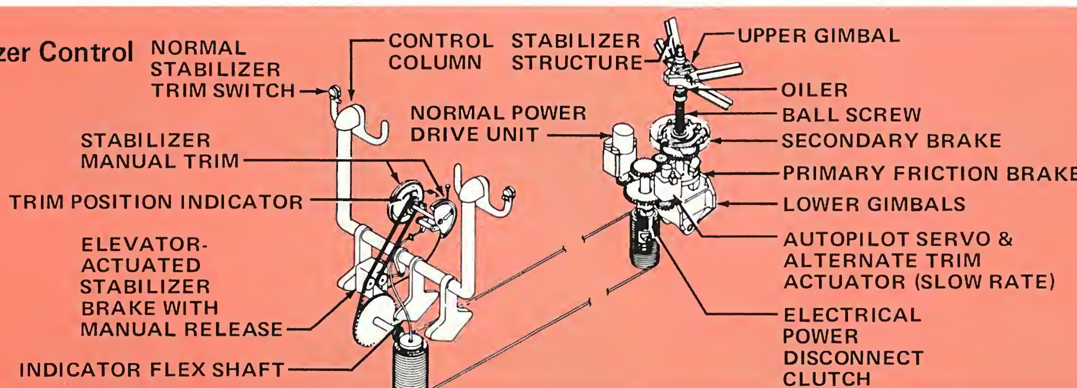


Longitudinal Trim

Longitudinal trim is accomplished by a movable stabilizer similar to the 707 and 727-200 trim systems. The stabilizer is powered by an electromechanically driven single-ballscrew jack. Two independent trim motors are used, and there is manual trim backup.

Manual stabilizer trim control wheels are located on each side of the cockpit control pedestal for manual trim operation. An override device permits manual override of both electric trim systems. Movement of the control column in the opposite direction to the trim wheel actuates a brake that prevents an electrical out-of-trim condition.

Stabilizer Control

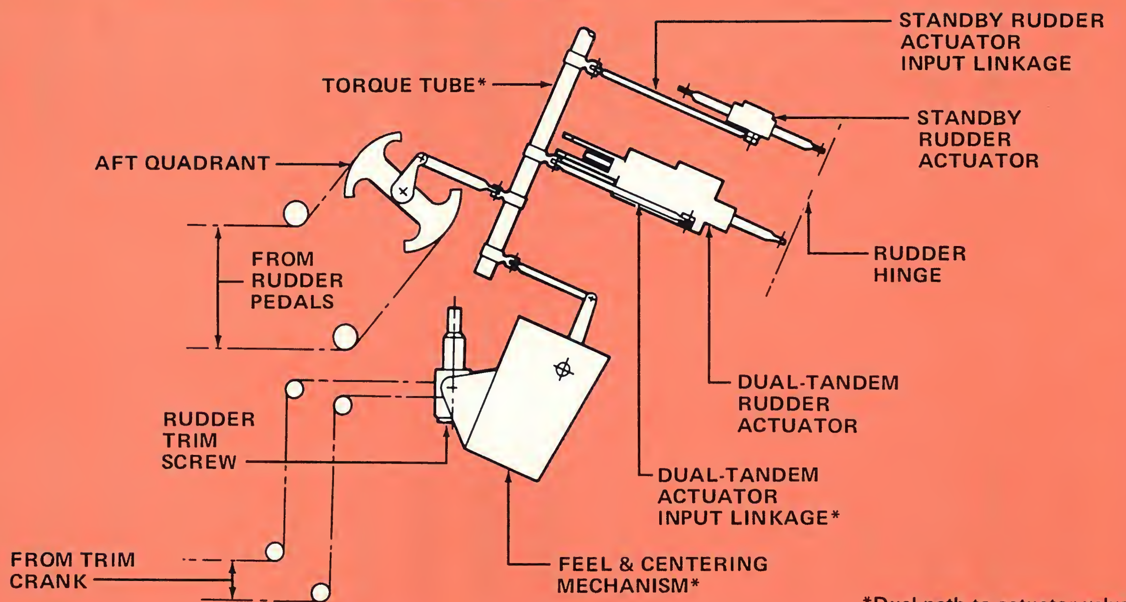


Rudder Control

Directional control is provided through a hydraulically powered rudder. A dual-tandem hydraulic actuator is connected directly to the rudder. It is powered by hydraulic systems A and B and operates through dual load-path linkages. Rudder power backup is provided by a standby actuator that is powered by the standby hydraulic system. Any single power source will ensure effective rudder control. Incorporation of the standby system has allowed simplification of the rudder control system by eliminating the need for rudder tabs, balance panels, and lockout mechanisms.

Rudder trim operates through a single closed-loop cable system from a trim knob on the control pedestal. It is mechanically connected to the power control unit through a jackscrew that shifts the position of the centering mechanism to a new center.

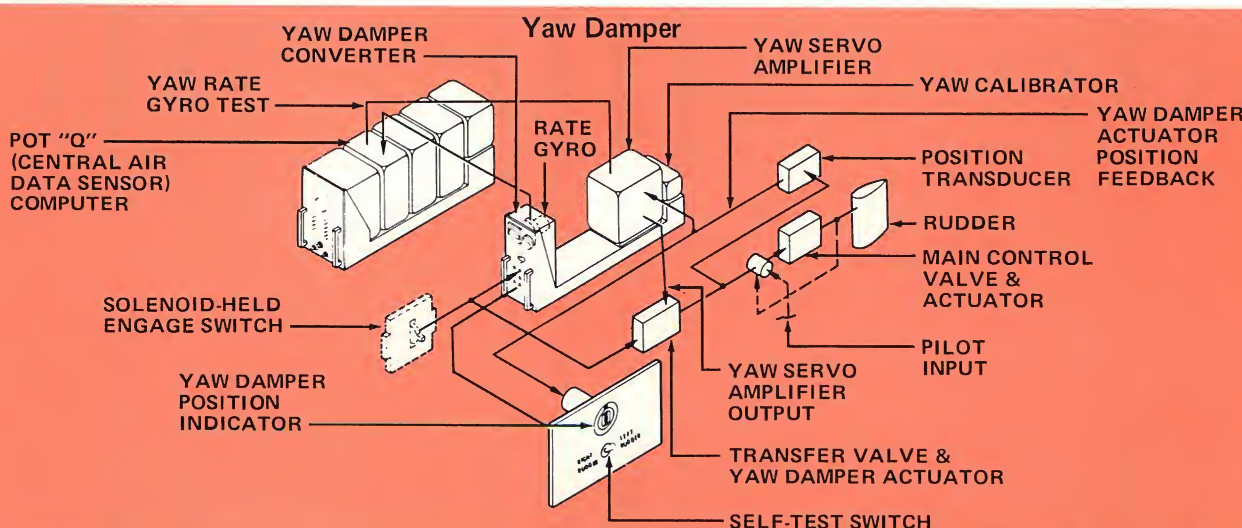
Rudder Control



Yaw Damper

The 737-200 has a single series-type yaw damper that is functionally independent of the autopilot. It operates the rudder through a transfer valve in the main power control unit. Yaw damper operation does not result in feedback at the rudder pedals and does not affect rudder feel or control. Full-time yaw damping is available over the complete flight envelope, including takeoff and landing. Because of its excellent Dutch-roll damping, the 737-200 can be operated with the yaw damper inoperative. The components are designed for low maintenance and contain self-test provisions.

Yaw Damper



Autopilot

The 737-200 autopilot, built by Sperry to Boeing specifications, represents a significant technological improvement over previous designs. The latest advances in microcircuitry, miniaturization, and solid-state electronics are employed.

The autopilot is integrated with the aircraft control systems by routing the autopilot signals directly to the power control units. This provides rapid and accurate control response without the use of a separate servo motor.

Pitch and roll signals may be switched to either power control unit for the elevators and ailerons for increased reliability of the autopilot. The primary inputs to the autopilot—such as vertical gyros, navigation receivers, and directional gyros also may be switched.

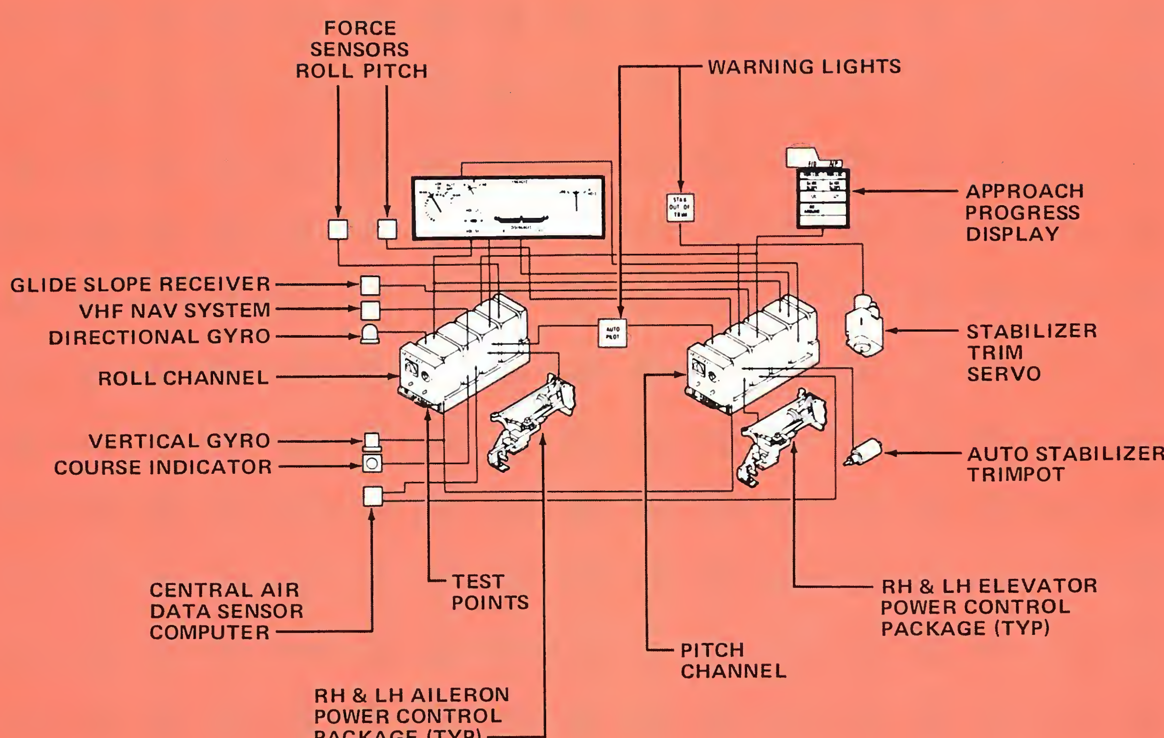
A feature of the 737-200 autopilot is control wheel steering. This allows commands to be given to the autopilot through the control wheel while the autopilot is engaged. Control wheel steering allows the pilot to remain in the control loop of the aircraft in a manner that is most natural to him, since wheel and column forces are similar to manually powered control forces.

The autopilot also features a turbulence penetration mode. Selection of this mode softens the pitch response and lowers the bank angle limits. This smooths the aircraft response during severe turbulence by preventing excessive movement of the flight controls. It also increases the fatigue life of the aircraft.

A central air data computer provides continuous data to the autopilot as a function of dynamic pressure. This feature ensures consistent autopilot performance throughout the operational range of the aircraft.

The autopilot system meets all FAA requirements for Category II weather-minimum capabilities. All major components of the autopilot have built-in self-test features that allow one man to check the autopilot system or its individual components. All components, including relays and interconnecting wire bundles, are mounted on a single detachable shelf for easy maintenance.

Autopilot



Landing Gear Features

- Landing gear simplified
- Right and left main-gear components interchangeable
- Main-gear body wheel well doors eliminated
- Hydraulic door sequence valves, pneumatic brake, and deboost valves not required
- Nose-gear doors mechanically actuated
- Hydraulic brakes powered by two independent systems
- 900-stop brakes, 25,000-mile wheels
- Pressure-modulated antiskid with automatic monitoring
- 40 x 14 standard tires
- C40 x 18 low-pressure tires

Main Landing Gear

The main landing gear system on the 737-200 is a simple, dual-wheel, conventional landing gear specifically designed to increase operational reliability and minimize maintenance. The most significant design feature is system simplification.

The main landing gear retracts straight inboard into the fuselage. The outer surface of the tire in the up-and-locked position fairs with the contour of the aircraft to form the main wheel well closure. The closure is completed by a blade seal. The only doors used on the main gear installation are small segments attached to the shock struts and slaved to the side brace. These doors close off the spanwise wing cavity.

Under the rigors of regular short-field operation, a soft-stroke landing gear is desirable. The air-oil shock strut of the main landing gear reduces landing impact loads by metering fluid through an orifice whose area is controlled by a contoured metering pin. By properly contouring the metering pin, the peak acceleration is reduced over a greater length of stroke. Thus passenger comfort is maintained for regular short-field operation and the landing gear and supporting structure stresses are decreased.

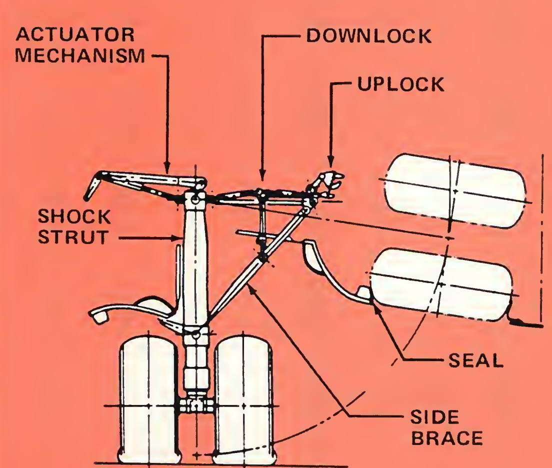
Brakes

The brake system consists of main-wheel multidisc, segmented rotor brakes powered by two independent hydraulic systems. Complete redundancy is provided by powering the inboard and outboard brakes with independent systems. Use of a dual brake system improves reliability and provides the following features:

- Simplified brake service and maintenance requirements
- Differential control for alternate brake operation
- Identical brake control from either pilot station
- Full antiskid protection

A selector switch allows the pilot to select automatic braking. With automatic brakes, braking at a preselected (MIN, MED, MAX) deceleration is applied automatically upon touchdown (wheel spinup). Uniform deceleration is maintained, even with variations in thrust reverser application. When the pilot elects to control the brakes manually, he may depress the brake pedals to deactivate the automatic system. He then increases or decreases braking effort in the normal manner.

Main Landing Gear



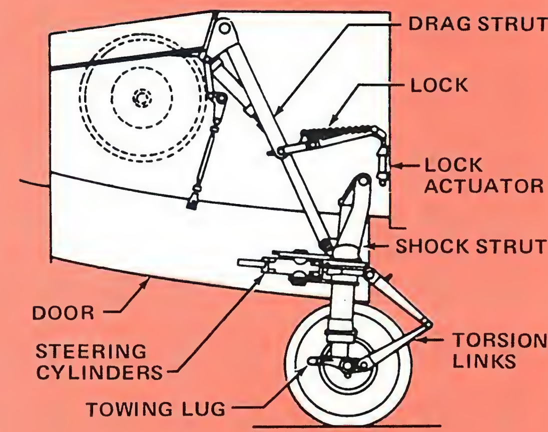
Nose Landing Gear

The nose landing gear is a conventional dual-wheel type that retracts forward. This installation is designed to minimize the number of functioning parts to increase reliability and system simplicity.

Features of the nose-gear installation include:

- A single up-and-down lock system operated by a single actuator.
- Two clamshell doors (actuated by pushrods) that remain open any time the gear is extended.
- Optimum integral shimmy damping as a result of transmitting nose-gear torsion loads directly into the nose-gear steering hydraulic cylinders.
- Nose-gear towing throughout the full steering range (± 78 degrees) without disconnecting the torsion links, provided the steering cylinders are depressurized through a switch on the hydraulic system.
- Nose-gear steering through the rudder pedals (±7 degrees).

Nose Landing Gear



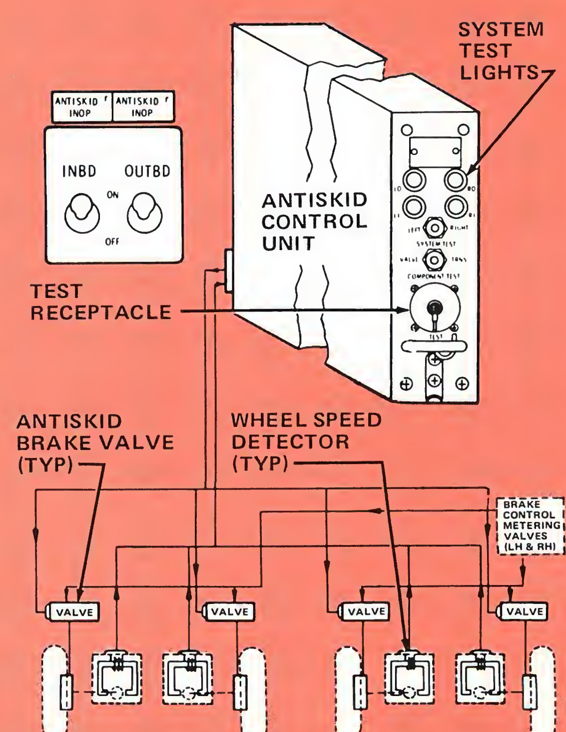
Antiskid System

Maximum braking efficiency for the 737-200 is achieved with a modulating antiskid system that senses individual wheel activity during a stop and automatically controls brake pressure to each wheel. The antiskid system operates in conjunction with the automatic braking system to maintain the selected deceleration rate. The system consists of individual, solid state wheel-speed transducers, one control unit, four control valves, two system-inoperative lights, and two on-off switches. The system has two completely independent control channels—one for the inboard and one for the outboard wheels. Braking of the aircraft is, therefore, always symmetrical.

The system, designed to relieve the pilots of any requirement for preflight tests, is self-testing: any loss of power to the system, an open valve, or open transducer circuit will cause the antiskid INOP light for the affected channel to illuminate. The lights and switches are arranged on a per-channel basis. If an inoperative channel light illuminates, that particular channel can be switched off and the antiskid OFF light will then illuminate. This is a constant reminder to the pilots that antiskid protection is not operating and that manual braking techniques should be used.

Ground test features are built into the antiskid control unit. Two test switches and four indicator lights located in the equipment bay are easily accessible to the ground crew for troubleshooting or for a quick confidence check of each channel. Precise performance and calibration checks can be made through a test receptacle located on the control unit. Most performance checks can be made with conventional electrical test equipment.

Antiskid



Electrical/Avionics System Features

- 40-kva isolated alternators
- Efficient constant-speed drive
- APU ground power and in-flight backup
- Proven raceway wire installation
- Best quality wire and standardized connectors
- Built-in checkout facilities
- Centralized electrical/electronics equipment with arrangement flexibility
- Equipment accessible for maintenance
- Reliable external light installations

Electrical System

The 737-200 is equipped with proven power-generating equipment. Control units incorporate the latest micro-miniaturization concepts.

Primary 115/200-volt, 400-cycle ac power is generated from isolated 40-kva generators located on each engine. The dc system consists of three 50-ampere transformer-rectifier (TR) units, a 22-ampere-hour battery, and a battery charger. The APU drives a single 40-kva generator that may be used for main generator backup power in flight and can also supply power to all aircraft busses on the ground.

The Sundstrand 40 axial-gear-differential drive has achieved the greatest time between overhaul (TBO) and the lowest operating cost of any drive yet designed.

Maximum power reliability is provided by a cross-type power distribution system that isolates generators and bus systems. This prevents a fault or malfunction in one generator system from affecting the remaining systems. Pilot electrical load management has been reduced to a minimum. In case of an engine or generator failure, loads that are necessary to maintain all primary flight functions are automatically transferred from the dead bus to the remaining generator system.

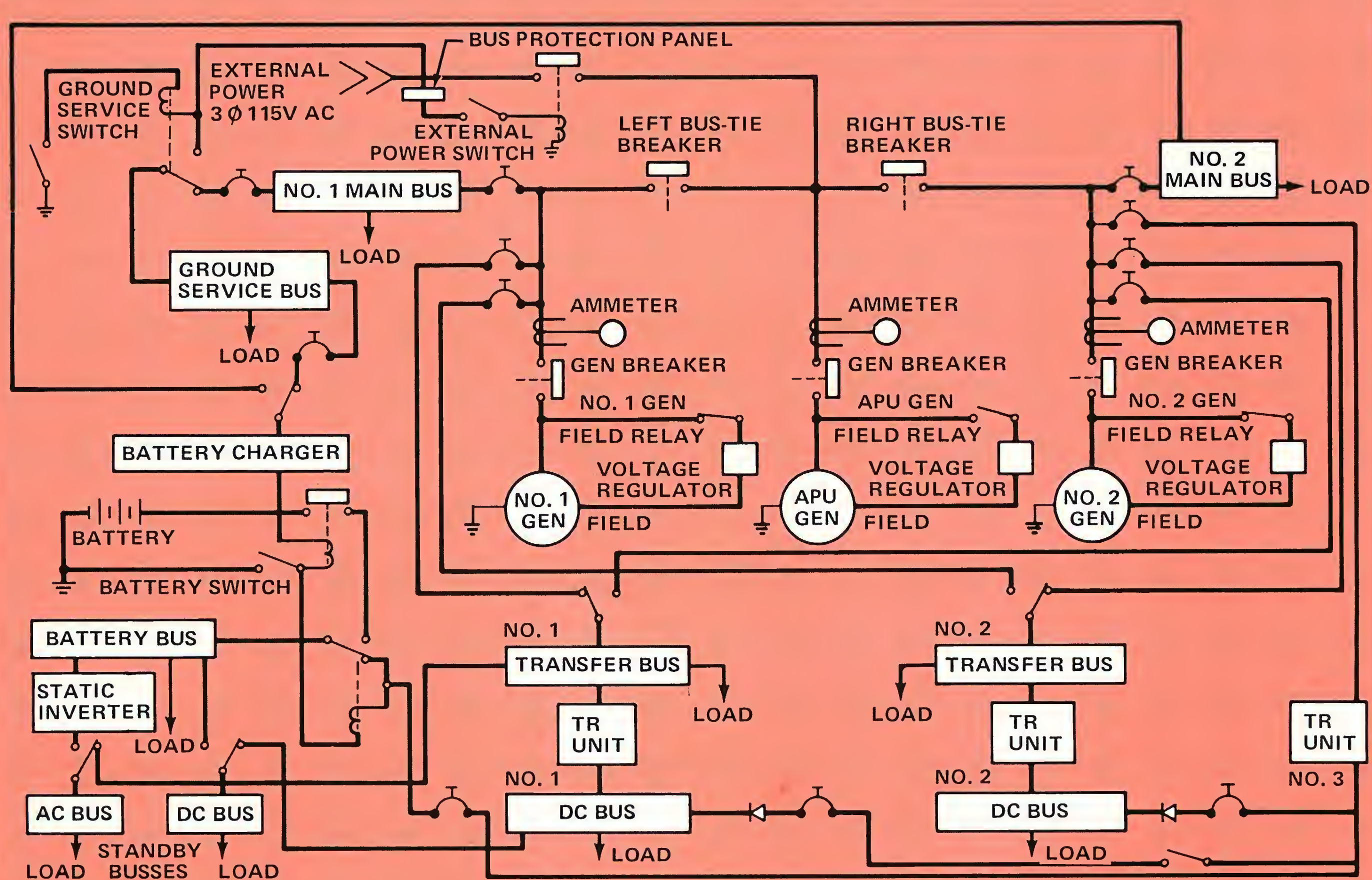
This constant essential power capability allows the pilot to continue normal flight operations until he can review the electrical panel and take remedial action. Transferred essential loads will not cause an overload sufficient to trip the remaining generator. The APU may be started to assume the total load of the dead system.

The dc power distribution system also has automatic power acquisition to preclude any interruption of power to essential avionics, operational instruments, and operational flight instruments or flight controls. Included is a battery and inverter standby system. This standby system automatically supplies ac and dc power for essential functions to ensure continued safe flight with all generators inoperative. These functions include:

- Navigation lights
- Engine and APU start and ignition
- Emergency exit light control
- Emergency dome lights
- Fire detection and extinguishing
- Captain's flight instruments (compass, artificial horizon, VHF communications, and VHF navigation)

Electrical power requirements for ground operation can be supplied either by the APU or from a ground power supply. In either case, all loads can be powered. Protective circuitry and interlocks prevent paralleling of any external generator with aircraft generators. Aircraft systems are protected from under-voltage, over-voltage, and phase reversal conditions arising from an improperly controlled ground power source or a malfunction in the aircraft generating system.

Power Distribution



Avionics System

The 737-200 avionics consist of basic commercial equipment augmented by special military communication and navigation systems. Suggested equipment for the various missions is shown in the table below. These configurations are based on anticipated mission requirements and can be tailored to meet specific needs or special preferences.

Modular unit construction and centralized grouping of components located in ground-accessible equipment racks enable easy equipment checkout and maintenance. A combination draw-through and area cooling system controls the ambient temperature and provides for units requiring forced-air cooling.

Navigation

The basic commercial navigation systems retained in the 737-200 for military service are the dual VOR & ILS, marker beacon, dual LF-ADF, DME, ATC, low-range radio altimeter, and weather radar. Second system options for DME, ATC, and low-range radio altimeter are available.

A single TACAN navigation system and an IFF/ATC system have been added to the basic commercial equipment to ensure compatibility with military installations. An optional inertial navigation capability is offered to improve accuracy on long-range missions and ensure satisfactory operation over water or in remote locations.

Avionics Equipment

Function	Equipment Vendor	Equipment Type
VHF Communications	Wulfsberg	WT-2000
Passenger Address	Pacific Electro Dynamics	255-5
Interphone	Boeing	65-52804
Music Reproducer (Optional)	Sundstrand	980-9301-001
SELCAL (Optional)	Motorola	NA-134D2
ADF-LF	Collins	51Y-7
Marker Beacon	Collins	51Z-4
VOR/ILS With Glideslope	Collins	51RV-2B
DME	King	KDM 7000A
ATC	King	KXP 7500
Weather Radar	RCA	Primus 90
Autopilot	Sperry	SP-77
Flight Director	Collins	FD-108
Air Data Computer	Honeywell	HG 180U
Low-Range Altimeter	Honeywell	HG 7502 BC02
Gyro Compass	Sperry	C-9D
Standby Horizon	SFENA	705-7-V4
HF Communications	Collins	618T-2
UHF Communications	Collins	AN/ARC-109
IFF/ATC	Hazeltine	AN/APX-72
Inertial Navigation (Optional)	Litton	LTN-72
ADF-UHF (Optional)	Collins	AN/ARA-50
Tacan	Hoffman	AN/ARN-84
Rendezvous System	Motorola	SST-183

Communications

A single HF and dual UHF radio system augments the dual commercial VHF system to ensure voice communications compatibility with a variety of ground terminals. Additional long-range communication, air-ground-air multiplexing, and secure voice or teletype can be provided if required for special missions.

Separate flight and service interphone systems are provided in the 737-200. The flight interphone permits communication between flightcrew members and between flight crews and ground crews. The service interphone allows communication between the flight crew, cabin attendants, and maintenance personnel. The interphone systems are powered from a dual source to ensure uninterrupted operation during emergency or power-failure conditions.

A passenger address system provides voice communication or optional tape music broadcast to the passenger cabin. Loudspeakers are installed in each passenger service unit for uniform sound distribution. The public address system operates from the battery during primary power failure.

Flight Systems

Two independent Collins FD-108 flight directors, with Category II (1,200-foot RVR and 100-foot height) lower weather-minimum capability, are standard 737 flight systems. Features of the system include:

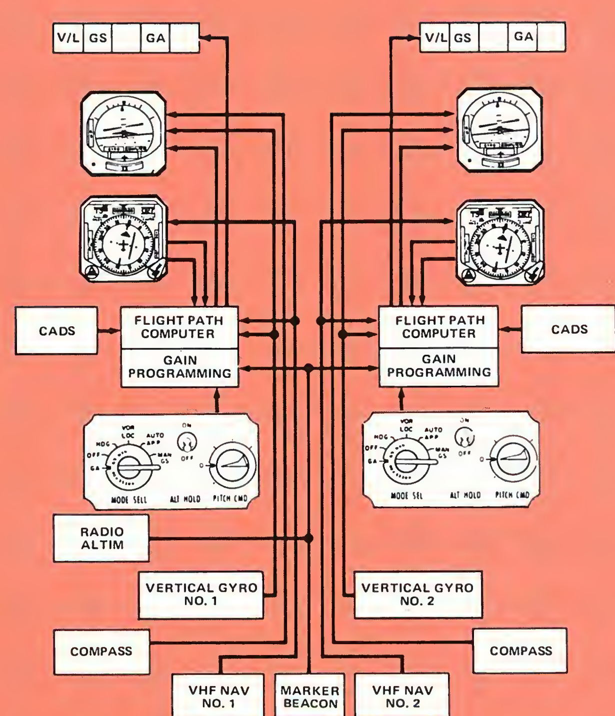
- Optimized glideslope and localizer dynamic response
- Integral command indication
- Warning of flight director failure

A progress-type mode annunciator, located near the attitude indicator, supplies VOR/ILS, glide slope, and go-around mode annunciation. Mode selectors are installed on the glare-shield above the pilots' main panels.

Two independent Sperry C-9D compass systems are installed. The 737-200 attitude system includes two vertical gyros with extensive inline monitoring. An optional third vertical gyro may be added to the system to provide improved dispatch capability and inflight attitude reference backup. A standby horizon indicator, powered from the battery, is standard equipment in the basic 737-200.

Dual compass, attitude, and VHF navigation systems with switching give the captain and first officer a choice of selecting input data to their respective flight instruments.

Flight Director



A Collins 54W-1D instrument warning system compares the output of the pitch and roll attitude, heading, and the localizer/glideslope deviation from the VHF navigation units and warns the pilots when a disparity is sensed between duplicate systems. The comparator may also include provisions for radio altimeter system comparison. Comparison monitoring, in addition to basic inline monitoring, ensures a high degree of confidence in the information displayed by the navigation instrumentation.

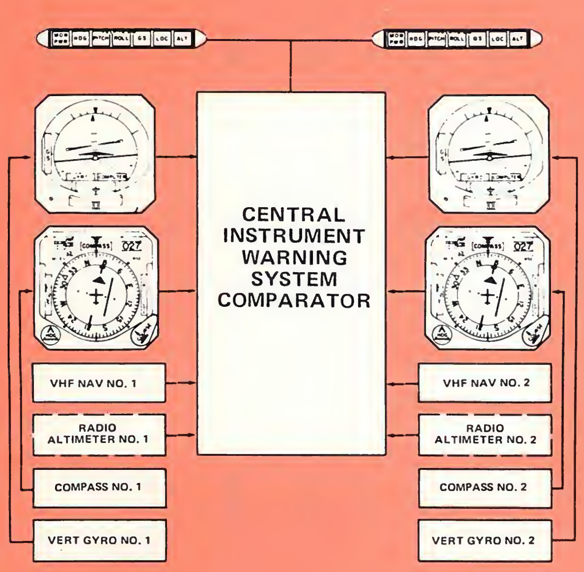
The central air data system is designed to fulfill the objectives of ARINC 545 characteristics. The "central" concept results in weight, space, and cost savings with easy expansion by addition of optional components. One computer in the aircraft serves as a sensor for the autopilot, flight director, cabin pressure system, altitude alert controller, captain's altimeter, and mach trim and engine pressure-ratio limit/total air temperature indicator. Installation space and wiring is included for a second computer and also for an altitude reporting system. Additional computer outputs for the flight director, autopilot, flight recorder, and mach meter are available.

Altitude alert warning lights are located adjacent to the altimeters, and the aural warning unit (three-chord tone) is located in the overhead panel.

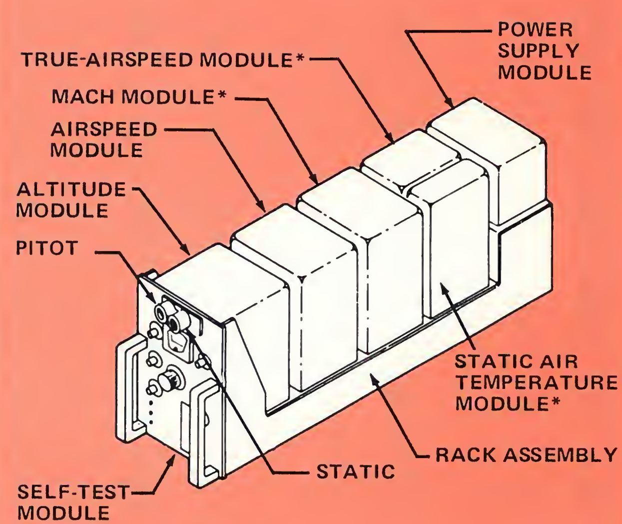
A performance data computer system (PDCS) provides flight profile information, including optimum airspeed and power (EPR) settings for various flight modes. Flight mode selection includes: standby, takeoff, climb, cruise, descent, hold, continuous, go-around, and turbulence.

In addition to the flight modes described above, performance functions are available in the PDCS that enable the pilots to investigate alternate flight profile information on the CDU while en route. Displayable parameters include: time remaining, distance, optimum and maximum altitudes, ground speed, fuel remaining and estimated fuel over destination, current temperatures and true airspeed, reference landing speeds, and wind information.

Instrument Comparison and Warning



Central Air Data Computer



*Optional modules

Inertial Navigation System

The optional inertial navigation system (INS) provides automatic aircraft navigational guidance with a degree of accuracy and reliability unattainable with other types of navigational equipment.

INS provides domestic and long-distance overwater guidance without the need for ground-based facilities. Comprehensive navigation information is continuously available for display to the pilot.

Significant cost savings and cost avoidance have been demonstrated through the use of INS.

In the INS design, consideration was given to providing for the maximum expected requirements of an inertial system. A modular building-block approach was used in the design to provide "growth space" for expansion to meet future navigational and/or computational requirements.

Flight safety is enhanced through reduced pilot workload.

Inertial navigation systems meeting the requirements of ARINC 561 are currently manufactured by several electronics companies. INS has been unquestionably accepted and proved as the standard navigation and attitude device aboard modern jet aircraft throughout the world.

INS Benefits

- Operationally superior
- Cost effective
- Growth potential
- Flight safety enhanced

Inertial Navigation System Components

The control/display unit displays navigation and steering information to the crew. In addition, this unit contains controls for insertion of present position, waypoints, and destinations in the form of latitude and longitude inputs.

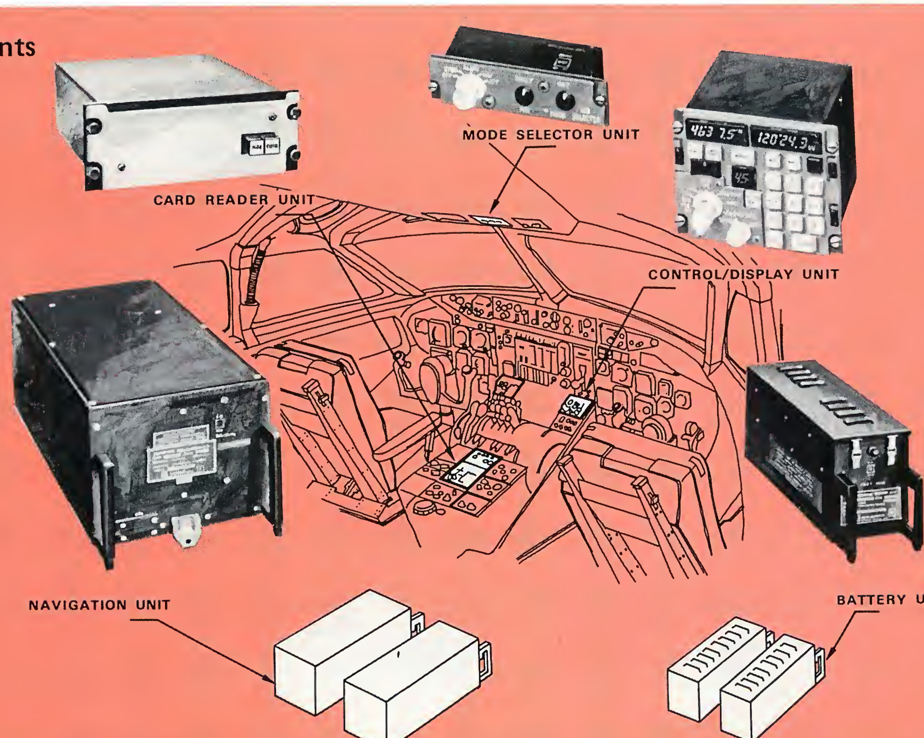
The mode selector unit allows selection of the basic system operating modes.

The navigation unit contains the major system elements: the stable platform, platform electronics, digital computer and its associated input/output hardware, and the charging circuitry for the battery unit.

The battery unit is used to power the system during any interruptions in the aircraft power supply. Both 15-minute and 30-minute battery units are available.

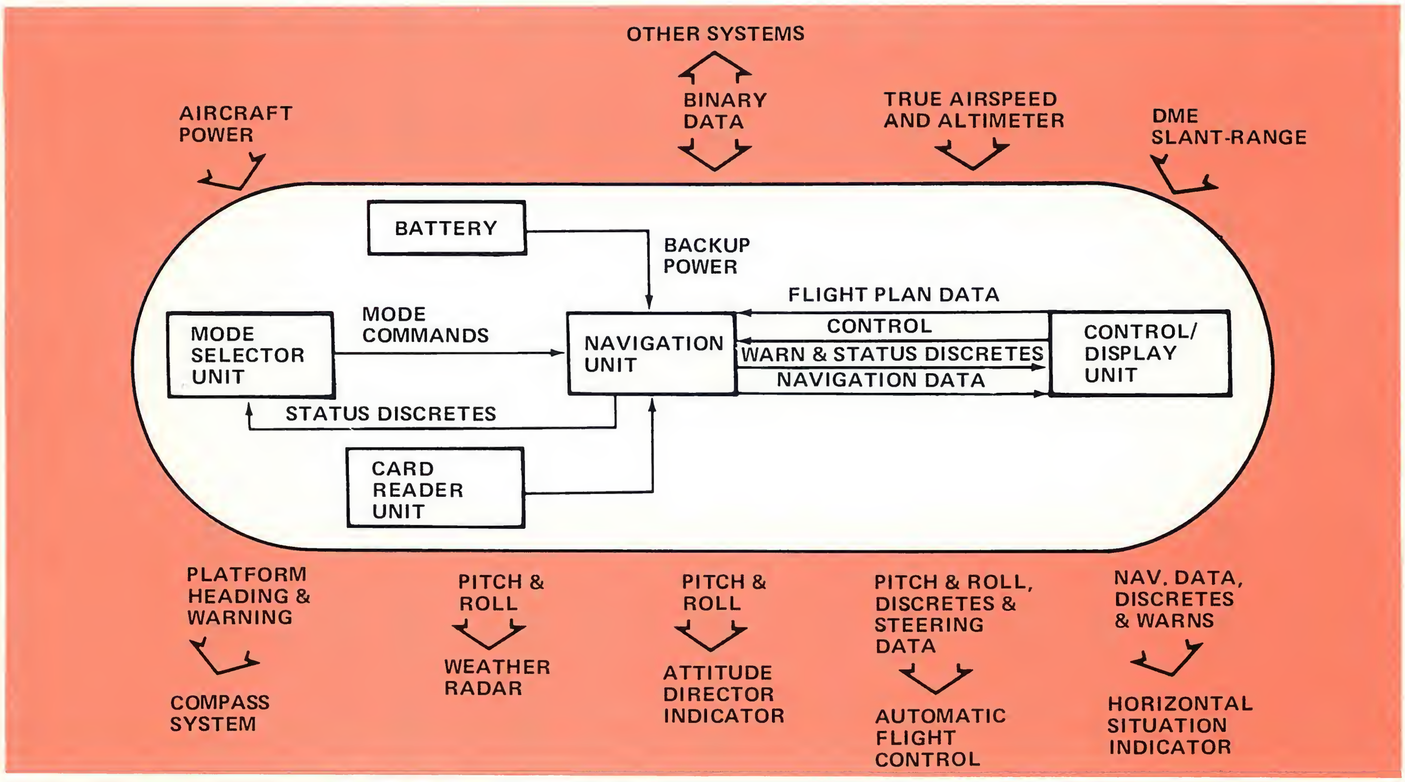
The optional card reader unit may be used to automatically load flight plan information into the navigation unit.

INS Components

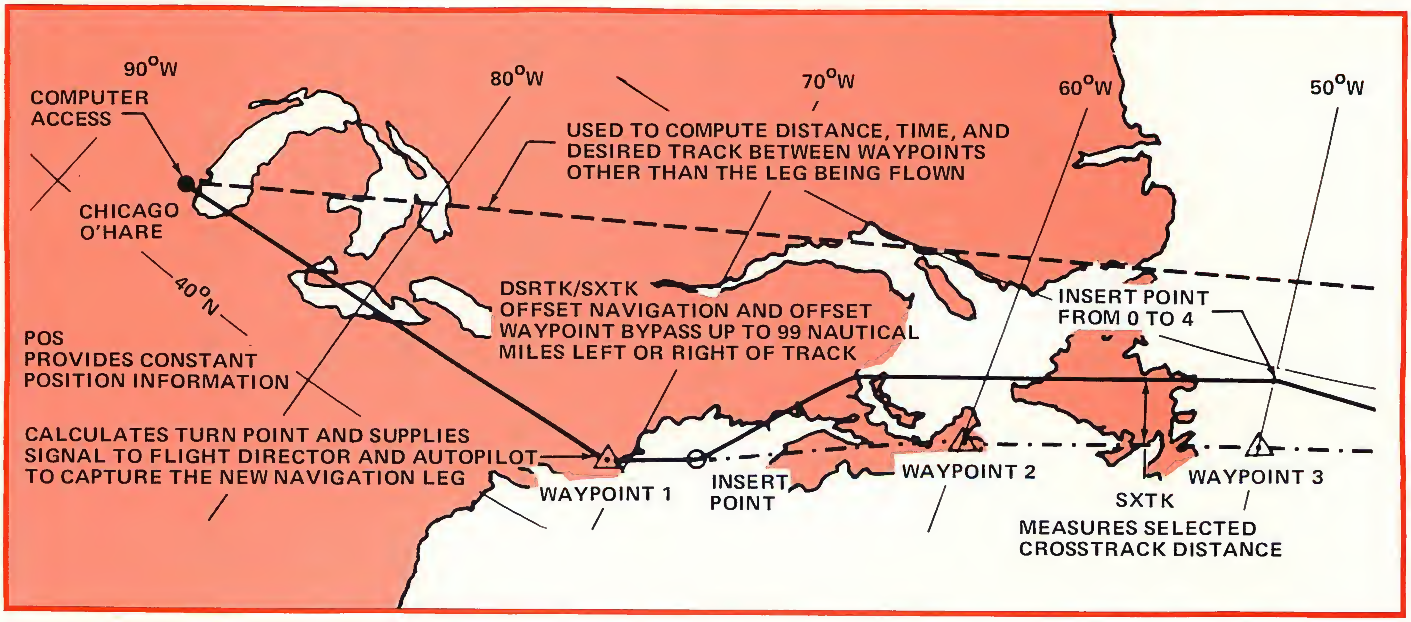


Signal Interface

The inertial navigation system interfaces with many aircraft subsystems. Inputs are provided from power and air data systems. Outputs are available for use by the automatic flight controls, horizontal situation indicator, attitude director indicator, compass coupler, weather radar, and other navigation systems.



Shown below, across adjacent pages, is a representative track chart for a flight planned and flown with an inertial navigation system.



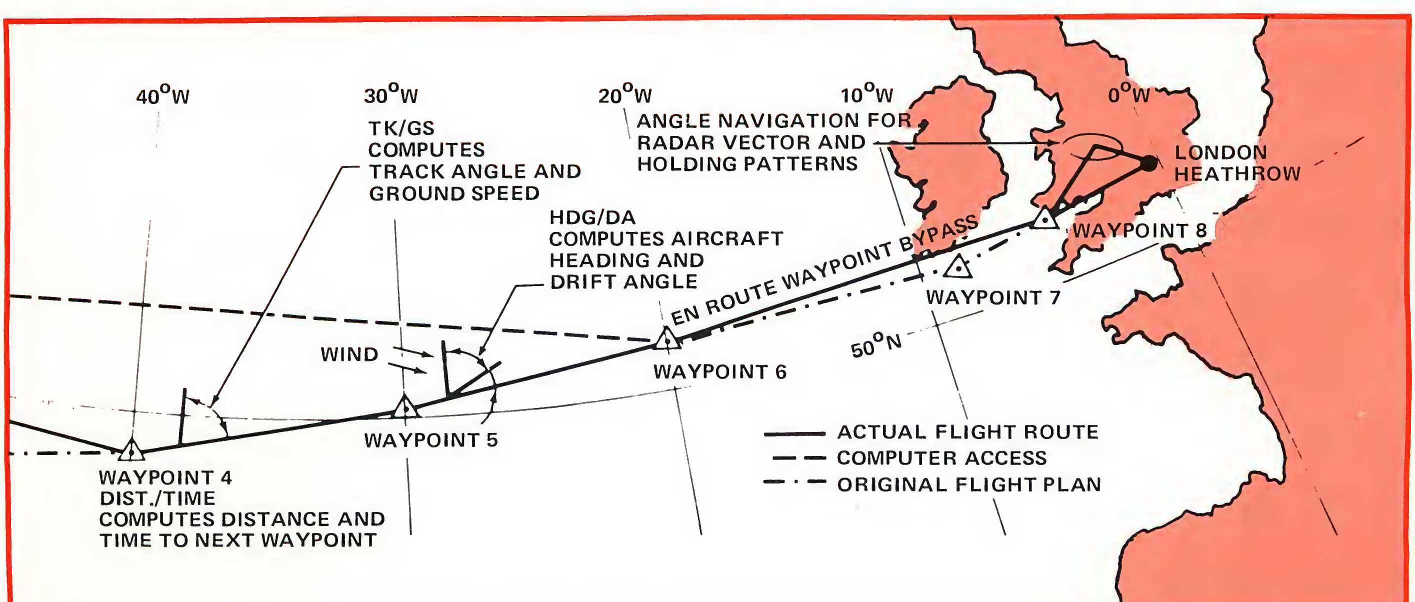
Operational Benefits

The inertial systems may be operated manually or automatically. Flight plan changes can be inserted in flight, bypassing preloaded waypoints to alter a flight plan. A typical installation consists of two inertial navigation systems.

Steering commands may be provided to the autopilot and the aircraft flown through predetermined waypoints to destination. In addition, attitude control is supplied to the aircraft and panel instruments.

Throughout the flight, aircraft position is accurately displayed on the control/display unit. Also available are data pertaining to track and ground speed, heading and drift angle, track angle and cross track distance, time and distance to next waypoint or destination, and wind direction and velocity. The system contains provisions for detecting operator errors; the pilot is notified by a flashing light on the key through which the error was committed.

- Continuous, Precise Knowledge of Aircraft Position
- Automatic Great-Circle Flight Plan Steering
- Precision Track Monitoring
- Minimum Flight Time
- Quick and Accurate Data Readout
    - Ground Speed
    - Drift Angle
    - Wind Speed
    - Wind Direction
    - Time/Distance To Go



Other Systems

Pneumatic System

Engine compressor bleed air is supplied to two air conditioning packs for cabin pressurization, temperature control, and ventilation. The auxiliary power unit (APU) also is a source of air that may be directed to either pack.

Each pack consists of an air cycle machine, primary and secondary heat exchangers, and a means of controlling airflow to maintain a comfortable cabin temperature by either cooling or heating on the ground as well as in flight.

Conditioned air is distributed uniformly from overhead vents throughout the length of the cabin and is exhausted through floor-level return air openings in the sidewall. Each passenger and crew position is supplied air by individually adjustable fresh air outlets; full-flow capacity is maintained by use of an electric blower. Air temperature is controlled by a solid-state temperature control system.

A fully automatic pressure control system allows the crew to preset pressurization conditions prior to takeoff; the system programs cabin pressure in proportion to aircraft altitude for the entire flight segment. The automatic control reduces crew workload and eliminates pressure "bumps" on takeoff and landing. One fully automatic, one semiautomatic standby, and two manual modes of operation are available. The standby system automatically takes over if operating limits are exceeded in the automatic mode. A cabin pressure differential of 7.5 pounds per square inch (.53 kilograms per square centimeter) ensures sea-level cabin pressure to 18,500 feet altitude. At 35,000 feet, the cabin altitude is 8,000 feet.

Engine bleed air also is used for thermal anti-icing of the engine inlets and leading-edge slats. Empennage anti-icing is not required.

Oxygen System

Two oxygen systems are installed: a demand system for the cockpit and a constant-flow system for the main cabin. Oxygen bottles for both systems are located in the forward cargo compartment and are recharged by bottle replacement. Optional external recharging is available. Quick-donning masks are located adjacent to each crew member's seat in the cockpit. Portable oxygen bottles are installed in both the cockpit and main cabins.

Main cabin oxygen masks are installed in each passenger service unit and in each lavatory. The system is automatically charged and the oxygen masks deployed anytime the cabin altitude reaches 14,000 feet. The system can also be activated manually from the cockpit at any altitude should the need arise.

Lavatories

Two lavatories are located in the main cabin—one forward and one aft; however, two aft lavatories and one forward, or any combination of these three, can be accommodated. Each lavatory contains all necessary vanity items and a recirculating flush-type toilet. The toilet flushing mechanism includes a 115-volt motor-driven pump, a filter, and a flushing cycle timer, all readily accessible for easy maintenance. Corrosion-resistant materials are used for toilet construction, and the pump is capable of operating for extended periods without circulating water in case of filter clogging.

The toilets can be completely serviced from external service panels with standard service couplings.

Water System

The main cabin water system, using a single 30-gallon (114-liter) storage tank mounted below deck, supplies 20 gallons (76 liters) of potable water under pressure to the lavatories and galley. The system is filled and drained from a single point at an external service panel. Water quantity gauges are located at the service panel and in the aft galley area.

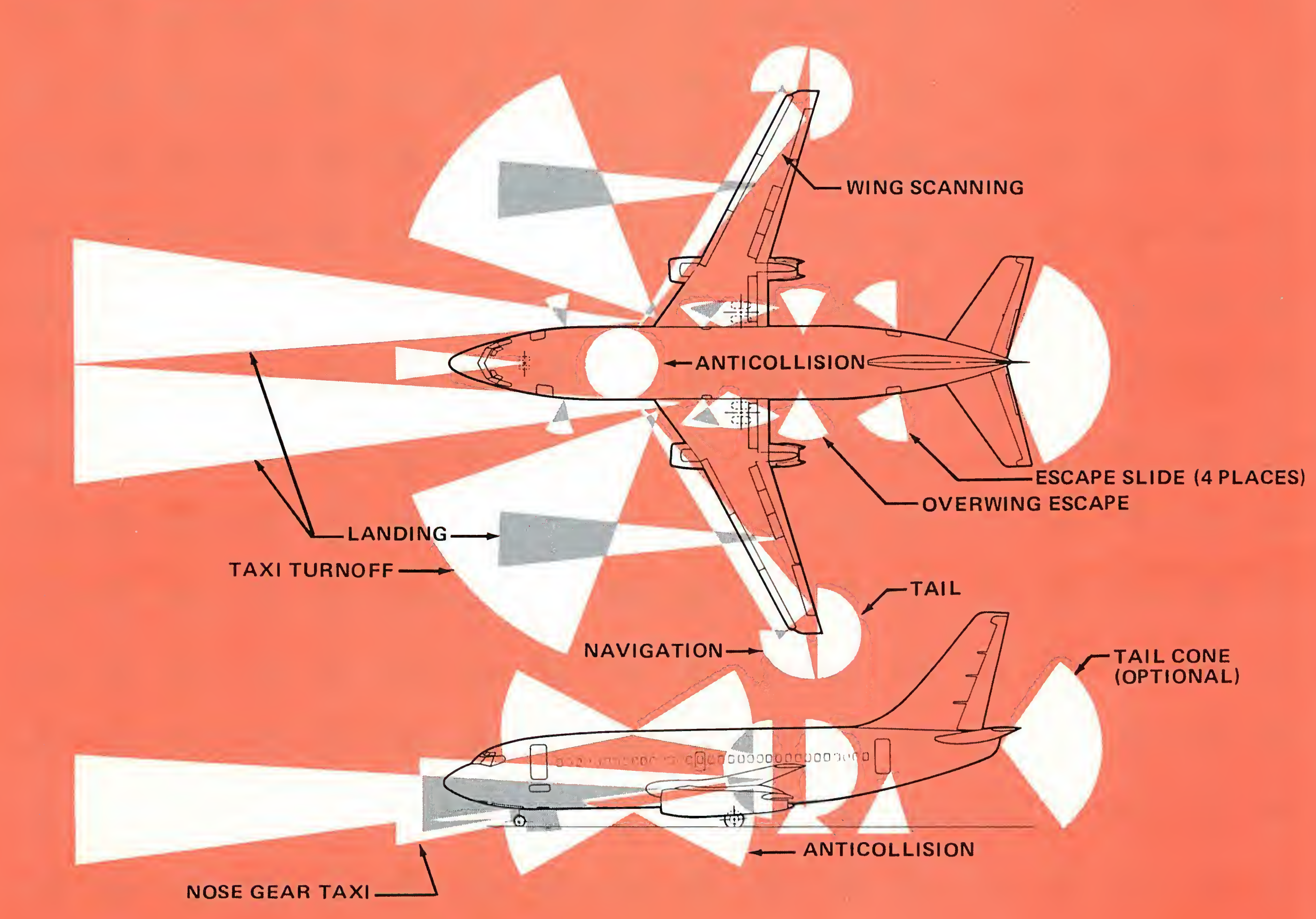
External Lights

Standard FAA-approved anticollision lights are installed on the upper and lower surfaces of the fuselage. Convenient access to the upper light for bulb assembly or removal is provided through the ceiling of the main cabin. The lower anticollision light is easily reached from outside the aircraft.

The 737-200 is equipped with four landing lights, only two of which are required for aircraft dispatch. Two of the landing lights are of the fixed type and are located in the leading edge of the wing to give maximum reliability. The other two are retractable and are located in the outboard flap track fairings to provide good visibility under adverse weather conditions. Placement of lights outboard minimizes reflected light in the control cabin.

Taxi turnoff lights installed in each wing root are focused ahead and to the side of the aircraft to illuminate taxiway turnoffs. Also available is an optional nose-gear taxi light for added taxiway visibility.

External Light Arrangement



Gravel-Runway Equipment

The 737-200 is certified by the FAA for operations from gravel and similar unpaved runways. Operators of the 737-200 fitted with optional gravel-runway equipment are now providing scheduled service to many areas of the world that were previously inaccessible to jet aircraft.

This capability applies to operation from gravel, coral, or similar runways having adequate bearing strength to support the weight of the aircraft. For improved flotation, the low-pressure-tire option is frequently specified in conjunction with the gravel equipment.

Gravel equipment is also available as a conversion kit for retrofit of 737-200s already in service.

Gravel-Runway Configuration

To permit operation from unpaved runways, systems were developed to prevent fuselage and engine damage from gravel spray during takeoff and landing. The following equipment is required:

- Main-Gear Gravel Deflector—a rubber panel installed between the tires aft of the axle

- Nose-Gear Gravel Deflector—a large shield installed on the nose gear to deflect gravel spray away from the engine inlets and fuselage

- Vortex Dissipator—a boom-like, high-pressure air duct extending forward from the underside of the engine to destroy inlet vortices by blowing air down and aft. This prevents pickup of debris from the runway surface

In addition, the following changes are incorporated to improve service life:

- Speed Brake Control Cable Protection—an aluminum shield on the main-gear strut over the ground speedbrake control cable

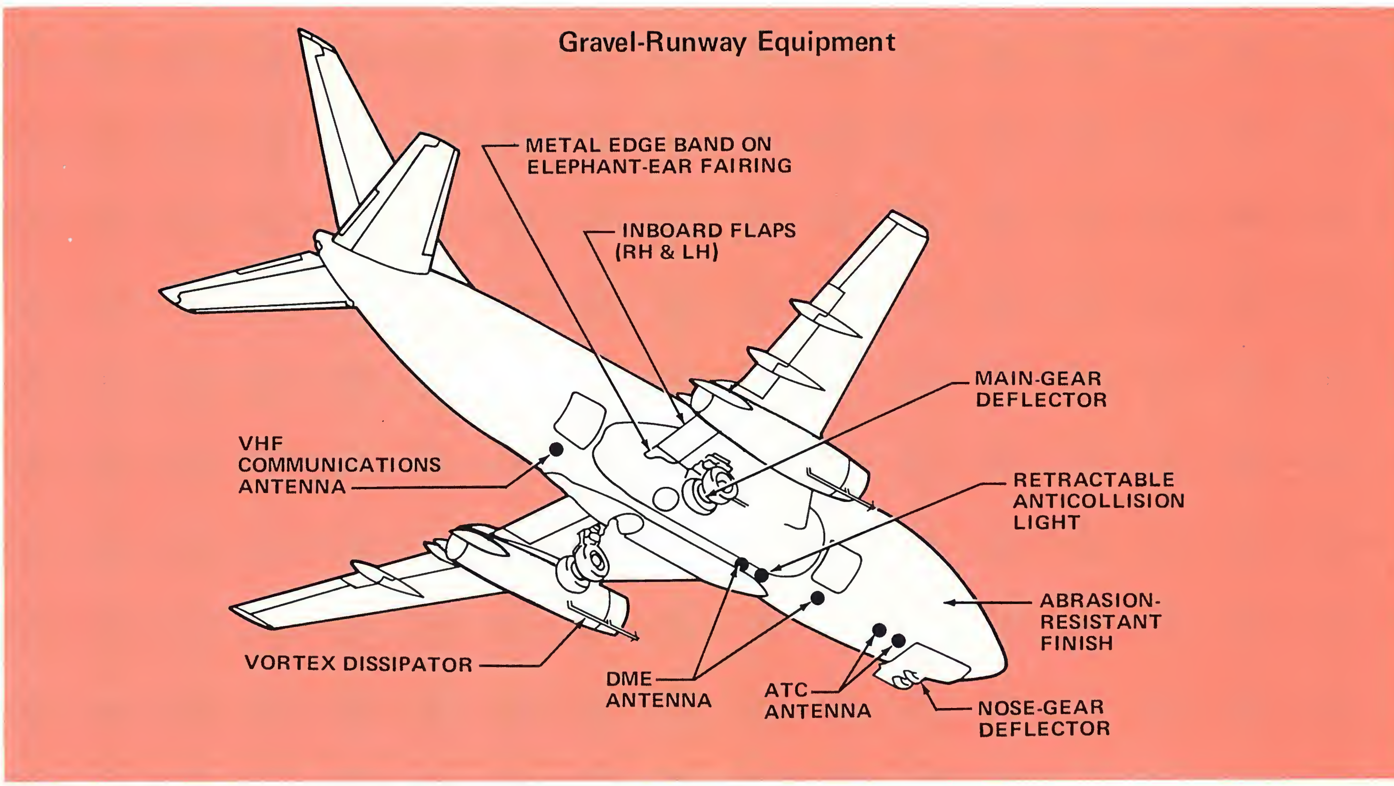
- Revised Antennas—a steel strip added along the leading edge of the VHF communications antenna and replacement of the aluminum DME and ATC antennas with stainless steel antennas

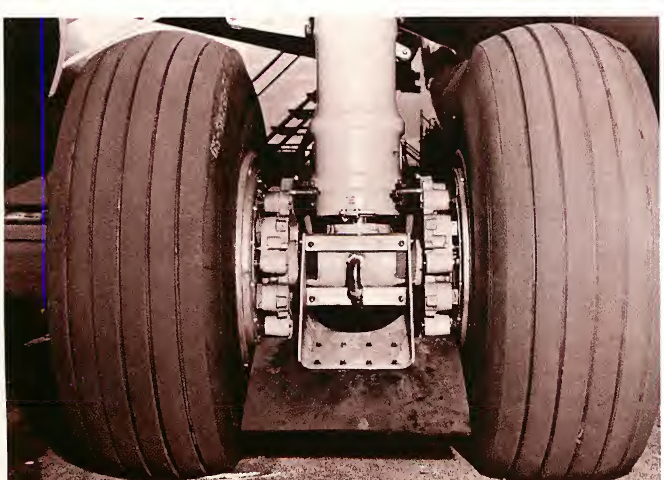
- Fuselage Abrasion Protection—abrasion-resistant Teflon paint on the fuselage lower surface

- Inboard Flap Protection—additional plies of Fiberglas on the inboard flaps, and aluminum sheet instead of Fiberglas on the inboard 5 feet of the aft flap

- Anticollision Light—the lower light is retractable

Vortex Dissipator





Main-Gear Deflector

Nose-Gear Deflector

Ice Protection

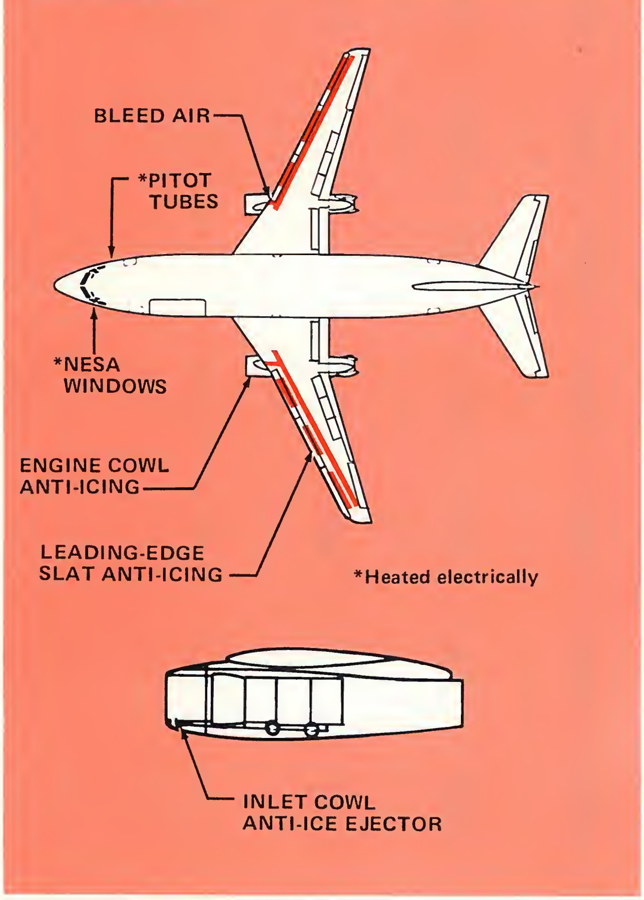
An electrical anti-icing system protects the windshield and pitot heads. Empennage anti-icing is not required on the 737-200.

Engine bleed air is used to prevent the formation of ice on the wing leading-edge slats, the engine nose dome, and the compressor inlet guide vanes and inlet cowl.

Eighth-stage engine bleed air is used to anti-ice the engine cowls, the inlet guide vanes, and the nose dome. Temperature-regulated thirteenth-stage bleed air is used for the nose cowl.

Eighth- and thirteenth-stage air is supplied to the wing anti-ice ducts from the pneumatic system and controlled by the wing thermal anti-ice valves.

Ice Protection



Independent Servicing

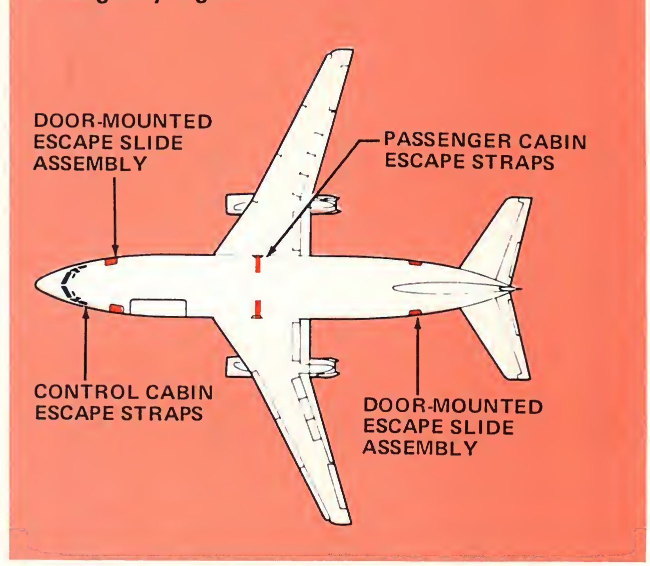
Galley servicing, lower-hold cargo handling, and aircraft fueling do not interfere with staff or crew traffic. In addition, nearly all service and inspection can be accomplished by personnel at ground level.

Emergency Exits

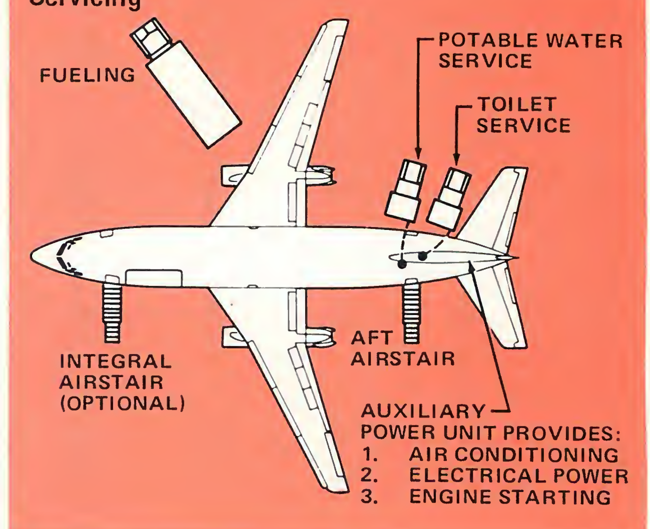
Emergency exits are positioned for easy access from anywhere in the cabin. An inflatable escape slide is located at each entry and service door. Escape straps are at each overwing exit and at each escape window in the control cabin. This exit arrangement satisfies the U.S. civil and military emergency egress requirements, even when half of the exits are unusable. All exits except the control cabin windows are identified by exit lights operated from battery power.

Emergency equipment installed in the basic aircraft are: fire extinguishers, portable oxygen bottles, crash axes, first-aid kit, and hand megaphone. Life rafts and life jackets for overwater operations are optional.

Emergency Egress



Servicing



Maintainability

The maintainability features of the 737-200 reflect the extensive design and maintenance experience acquired by Boeing through the evolution of three generations of jet aircraft. This experience was enhanced by the company's work with military and civil operators throughout the world.

To meet 737-200 maintainability objectives, Boeing combined the experience of its Service Department with the Engineering Department design know-how. Good maintainability must be designed into the aircraft—its structure and its systems. The extensive experience of Boeing in the manufacture of jet aircraft has provided a remarkable continuity of operating knowledge and design capability for improved maintainability.

Reliability

Dispatch reliability is defined as meeting mission departure schedules without a delay of more than 5 minutes due to mechanical reasons. To achieve the highest rate possible for the 737-200, each of its systems was compared—component by component—with actual delay experience on similar 727-200 systems. In comparing the various components, the 737-200 design team took into account the number of parts, duty cycle, design differences, environment, accessibility, and whether or not a serviceable component is a dispatch requirement.

The evaluations that followed focused attention on delay-causing systems and components so that their respective designs could be improved. As a result, the 737-200s now in service have achieved an overall dispatch reliability of 98.5% at an average daily utilization of 6.6 hours.

"Eye-Level" Maintenance

A unique characteristic of the 737-200 is its eye-level maintenance design. Nearly all maintenance may be performed at ground level without ladders, hoists, or other lifting devices. This means that the operator has little need to provide additional ground service maintenance equipment. Hydraulic units located in the main wheel wells are accessible to a mechanic standing on the ground. Air conditioning units under the wing center section are accessible through large doors. Electronic equipment is installed in racks in a bay aft of the nose wheel well. Major control system components in the wing are accessible through leading- and trailing-edge-flap openings.

Engines

Use of wing-mounted JT8D engines eliminates the need for high-hoisting engine-change equipment. All engine accessories can be serviced from the ground without the use of ground stands. Unlike most other short-range jet aircraft, the 737-200 may have engines changed at ground level with simple hand hoists attached to the aircraft structure. Powerplants are interchangeable left and right except for the nose cowl and thrust reverser. An engine change can be accomplished in less than 50 minutes, exemplifying the simplicity and accessibility of the engine installation.

Landing Gear

The simplified main-gear design and installation offer the operator the following advantages:

- Spares requirements are reduced and in-flight reliability is improved by elimination of a manual door-release system during freefall operation.

- Elimination of a ground door-opening system reduces parts and maintenance and improves service access to main wheel wells.

- In-flight brake cooling is improved by wheel well ventilation through vents in the outboard wheel hubcaps.

- Manual actuation initiates gear freefall and down lock is automatic.

Components of the main landing gear are designed to provide maximum service life and minimum spares inventory. The simplified geometry of the main gear has resulted in identical right and left gear components. All gear joints incorporate flanged bushings that ensure long life without galling, reduce wear on steel parts, and simplify maintenance by limiting rework at overhaul to bushing replacement.

The 737-200 brake hydraulic system does not require lock-out deboost valves. This improves anti-skid response and brake reliability. The system is self-bleeding. The bleeding normally required after brake change is eliminated as a result of the location of the hydraulic lines and the deletion of the deboost valves. Pumping of the brake pedals will remove any air bubbles from the brake line after a brake change.

High-capacity, rugged brakes with adequate spacing between units permit approximately 900 stops (at typical landing weights) between overhauls.

Brake maintenance is simplified by the incorporation of automatic brake adjusters and external indicator pins for visual examination of brake lining condition. Brake replacement is simplified by the incorporation of a three-bolt, quick-attach design.

Hydraulics

Hydraulic system maintenance requirements are kept low as a result of careful design and incorporation of the latest technological improvements. For example, low-friction, long-life Teflon and ethylene-propylene seals are used extensively throughout the system.

High system reliability also is achieved through the use of modular units that simplify fluid handling and reduce the number of fittings required. A pressure module is shown as an example. It consists of two pressure filters, two check valves, two pressure switches, a relief valve, a manual bypass valve, and two flushing plugs. Use of this modular assembly eliminates a total of 14 tubes and 32 hydraulic connections. The entire module may be replaced or individual components of the module may be replaced while installed in the airplane. Use of manifolds and special reducer fittings has eliminated the use of banjo-type fittings and other components that did not have an equivalent high standard of reliability.

Pressure Module

Flaps

The flaps are designed for durability and maintainability and include heavy-gage lower-surface skin attached with screws in easily removable sections. Minor damage to a flap lower surface does not require flap replacement but only quick replacement of the damaged skin section. For improved maintainability, flap drive power and angle gearboxes are "butter" lubricated to eliminate pressure testing and maintenance removals. The flap screw transmission gearboxes are oil filled for maximum reliability.

Other Systems

Major systems are grouped at readily accessible locations for easy maintenance. All fueling valves are installed at the fueling station outside the fuel tanks, ensuring service and maintenance accessibility. A junction box for fuel gage wiring facilitates the isolation of system malfunctions. Manual shutoff valves are installed throughout the hydraulic system to provide the capability of isolation and in-place testing. Internal leakage rates and pressure decay may be checked without component removal.

All major components of the autopilot and yaw damper, including airframe-furnished relays with connecting wire bundles, are mounted on a single removable shelf for easy maintenance.

A built-in checkout capability in the 737-200 electrical system facilitates operator identification of malfunctions. Checkout of functions, with convenient operation and test of the electrical system, can be made by one mechanic in the control cabin. Ease of electrical system maintenance is supplemented by efficient isolation of power-generating-system components and wiring, all individually accessible and removable without disturbing other components.

External light installations on the 737-200 have been given special consideration for reliability and easy maintenance. A new socket design used in navigation lighting increases the life of the lamps 6 to 10 times over lamps in conventional sockets. Dispatch capability of the 737-200 also is improved by installation of redundant light assemblies in each wingtip.

Customer Support Services

Customer Support Services

Worldwide, Boeing aircraft of all models average one landing or takeoff every 20 seconds, around the clock, with an on-time dispatch reliability averaging 97%.

In assisting operators to achieve and maintain this remarkable record, Boeing has built a network of customer support facilities to ensure that Boeing aircraft are "at home" everywhere in the world.

Technical assistance is available from field service engineers located at more than 75 bases covering all continents.

Spare parts are stocked in four strategically located centers and at the factory.

Support for each aircraft type begins at Boeing in the engineering conceptual stages and continues throughout the aircraft's service life.

Purchasers and operators of Boeing aircraft receive much more than the aircraft itself; they have the services of a skilled support organization whose total efforts are dedicated to assisting the operator in support of his aircraft.

Predelivery Planning

Aircraft Maintenance Support

Publications and Training Aids

Operations Engineering Support

Spares Support

Flightcrew Training

Maintenance Training

Predelivery Planning Data

Manuals needed for predelivery planning of aircraft operation, maintenance, overhaul, and personnel training are provided before aircraft delivery. Manuals can be furnished in any required format. Currently they are delivered worldwide in formats ranging from "hard copy" to microfiche. These predelivery manuals include:

- Maintenance planning data
- Maintenance and operations planning simulation
- Maintenance program techniques
- Maintenance man-hour analysis
- Maintenance program experiences
- Facilities planning document
- Illustrated tool & equipment list

Using the Boeing maintenance planning data and documents, the operator can appraise his own facilities and readily plan any changes required. Specialized engineers are available for consultation. Boeing's Support Equipment Group designs special tools and equipment needed to service and maintain new or derivative aircraft.

Provisioning documentation, customized to include only those parts effective on each customer's aircraft, is provided on a timely basis using the latest electronic data processing techniques. Mechanized data in the form of magnetic tapes and punched cards supplement the basic provisioning documentation for operators using automated systems.

Publications and Training Aids

Maintenance Manual

A separate maintenance manual, prepared for each operator's aircraft, contains complete instructions for ramp, line, and hangar maintenance of all installed systems and components, including vendor equipment and operator-furnished equipment. The descriptive portions of the maintenance manual are suitable for use in classroom instruction. This manual provides sufficient information to permit a technician who is not familiar with the aircraft to service, test, troubleshoot, and repair all systems and units and to remove and replace any unit on the flight line or in the hangar.

Overhaul Manual

The Boeing overhaul manual contains complete overhaul instructions for repairable components. Each component is covered in a separate manual that provides: descriptive information; repair, assembly, and testing procedures; and an illustrated parts list.

Structural Repair Manual

Separate structural repair manuals are prepared for each basic aircraft model. Each manual contains descriptive information and specific structural data pertaining to the repair of primary and secondary structure. All repairs contained in the manual are FAA approved.

Illustrated Tool and Equipment List

This list describes equipment procurement and use and includes pictorial descriptions of Boeing special and nonstandard tools.

Nondestructive Testing Manual

The nondestructive testing manual consists of descriptive information and specific instructions and data pertaining to the nondestructive testing of the aircraft primary and secondary structure.

Service Bulletins

These notices provide current data about aircraft modifications and new components designed to improve safety, maintainability, and service life. Boeing service bulletins are issued on a timely and continuous basis as required.

Illustrated Parts Catalogue

The IPC contains line drawings of aircraft parts in assembly sequence along with appropriate part numbers for each. It is customized for each operator's specific aircraft model and special features.

Operations Manual

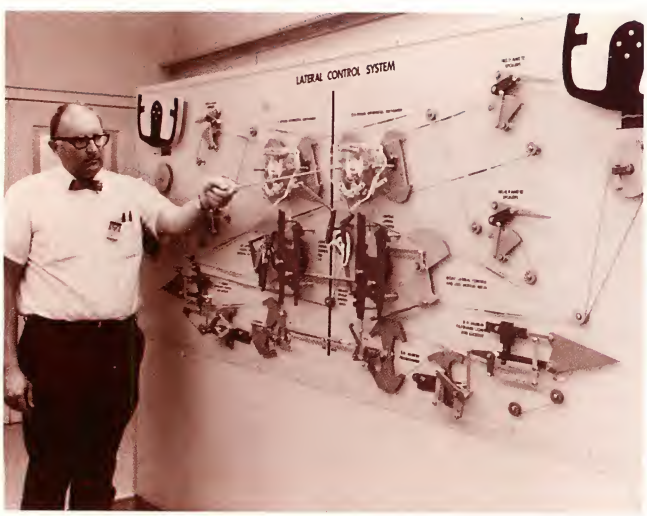
This manual has operational performance data for all phases of ground and in-flight planning.

Aircraft Flight Manual

The aircraft flight manual contains information essential for safe operation of the aircraft. This manual, as well as all subsequent revisions, requires coordination with and approval by the United States Federal Aviation Administration (FAA).

Performance Engineers' Manual

This document contains basic aerodynamic and powerplant data from which operations manual data are generated. It is also used as a mutual guideline in meetings and correspondence between the operator and Boeing Operations Engineering.



Training Aids

Illustrations and photographs are prepared for each operator and made available in a packaged program in the form of slides, transparencies, and films with appropriate taped commentary. Color is used in some of the illustrations to emphasize such key details as fluid flow or variations in pressure and temperature.

Projectable trainers, made of plastic, are transparencies with movable parts. Aids of this type are used to demonstrate action of complex mechanisms, otherwise almost impossible to describe or explain. Projectable trainers are small enough to be hand carried.

Spares Support

The Boeing spare-parts program provides efficient, economical support that ensures maximum aircraft utilization at minimum spare-parts cost to the operator. Years of experience supporting the worldwide operation of Boeing aircraft has resulted in a highly effective system administered by skilled personnel.

Boeing maintains a large parts inventory in the Seattle area, as well as at four other strategic points worldwide. Modern inventory management ensures a high degree of off-the-shelf parts delivery and keeps operators' costs down.

An experienced spares representative is assigned for each operator as a single factory contact point for all matters concerning spare parts.

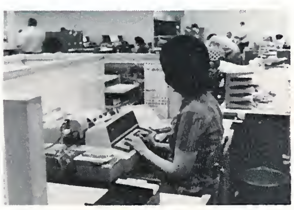
Customer orders are handled by electronic data processing. Accurate, current status reports ensure true jet-age support.

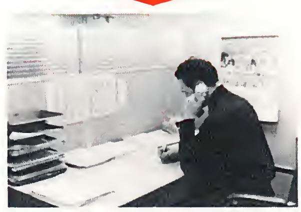
The Boeing spares department reacts instantly to emergency requirements. Trained spares representatives are on duty 24 hours a day, every day, to ensure that aircraft-on-ground (AOG) situations are met with prompt, coordinated action.

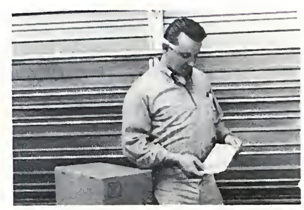
Parts for AOG requirements are shipped within 2 hours if available in inventory, and within 6 hours if available from the production line.


Operator

AOG orders on their way to operator's base

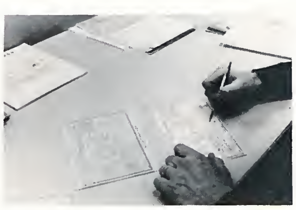

AOG logged in


Operator calls in "AOG"


AOG orders on shipping dock

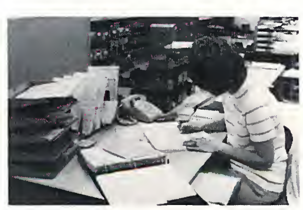

AOG order wire-transmitted from


Packaging


office to warehouse


Preservation


Status central—AOGs and routine


Available/not available status to office


World's largest aircraft mail order house

Maintenance Training

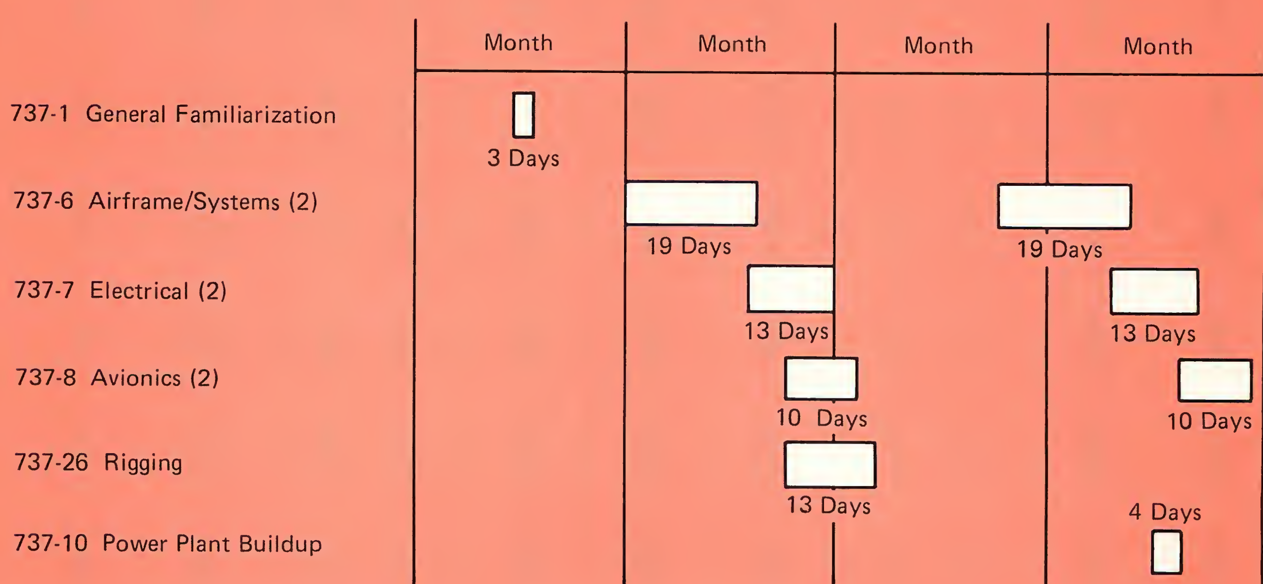
The Boeing Maintenance Training Center is international in scope. Operators, various government regulatory agencies, and other supporting organizations from all over the world make use of its services. The center plays a vital role in Boeing's continuing commitment to customer support.

The Maintenance Training Center is located at Boeing's Seattle, Washington, facility. It is situated near the engineering department and convenient to factory areas, shops, flight lines, and laboratories.

The school is equipped with classrooms, demonstration areas, and office space.

Originally opened more than 32 years ago, the school is dedicated to helping operators achieve maximum safety and efficiency in operation of Boeing aircraft. Creation of a balanced environment with a highly qualified staff, effective training aids, and modern facilities and methods has allowed the center to attain its objective. An integrated training curriculum is developed to meet the specific requirements of each operator.

Maintenance Training Courses



Description of Maintenance Training Courses

737-1 GENERAL FAMILIARIZATION—General aircraft information; primarily for command and planning personnel.

737-6 AIRFRAME AND SYSTEMS—Detailed description and operation, servicing, and recommended line maintenance practices with respect to the airframe and systems; for mechanics and instructors.

737-7 ELECTRICAL SYSTEMS—Detailed description and operation, servicing, and recommended line maintenance practices with respect to the electrical systems; for electricians and electrical instructors.

737-8 AVIONIC SYSTEMS—Detailed description and operation, servicing, and recommended line maintenance practices with respect to the electronic systems; for electronic technicians and electronic instructors.

737-10 POWER PLANT BUILDUP—Information on the technique and sequence of buildup of a basic engine to its installed configuration; for engine specialists.

737-26 RIGGING—Information on rigging procedures for all aircraft systems that require rigging; for rigging specialists.

Materials Provided to Students:
Training manuals
Graphic aids manuals
Field trip checklists

Materials Provided to Operator:
Graphic aids (35mm slides)
Training manuals
Course outlines
Field trip checklists
Wall charts
Examinations
Student records and completion certificates

Maintenance Training Aids

PANEL TRAINERS—Show areas of the aircraft having complex mechanisms that are otherwise difficult to explain simply or quickly.

SYSTEM TRAINERS—Sophisticated teaching aids that contain many actual aircraft components. They show complete systems so that operation and maintenance procedures and techniques may be demonstrated and practiced.

COCKPIT TRAINER—Makes possible rapid familiarization with the location of controls and equipment. It also permits practice in performing normal maintenance checks and in isolating simulated system faults.

Flight Crew Training

The flight crew ground training program is the first phase of the total flight crew training program. This course includes appropriate system descriptions and performance information, with emphasis on normal, abnormal, and emergency procedures.

Flight training manuals for each aircraft are designed to guide students through the flight training courses in the most logical and effective sequence.

The flight crew training program includes extensive use of modern flight simulator equipment designed specifically for each model of aircraft. These simulators enhance training productivity and crew coordination.

The final phase of flight crew training consists of inflight instruction by highly qualified Boeing flight instructors. In addition to conducting training in the Boeing factory area and elsewhere in the United States, Boeing instructors are assigned to the operator's base for as long as necessary to ensure smooth introduction of the new aircraft to the operator's mission. They frequently participate in the operator's initial missions and recurrently as required.

Operations Engineering Support

The Boeing Flight Operations Engineering Unit provides specialized operational engineering assistance to each operator.

Operations engineers develop performance charts for operations manuals, provide counsel in all areas related to aircraft operation and performance, and correspond with the operator to keep him advised of new developments in this area. Their assistance in airfield and mission analysis and in tailoring flight manual information as well as aircraft loading and trim information to the structure of a specific mission is particularly beneficial to the new operator.

The Flight Operations Engineering Unit prepares the limitations and procedures sections of flight manuals and coordinates the complete flight manual for government regulatory agency approval.

Field visits are an important function of this unit. Specialists often visit the operator's base to train personnel in the use of performance charts or to give on-the-spot assistance in resolving operational or performance problems. They monitor the operator's flight techniques to ensure best performance and conduct performance audits to determine whether the aircraft is performing according to specification.

A performance analysis program is continually available to operators. Inflight cruise readings are programmed through computers. Printouts are analyzed by operations engineers who study problem areas and recommend corrective action.

Aircraft Maintenance Support

Field Service Engineering

A field service engineer is permanently stationed at the operator's main base before the first aircraft delivery. He is experienced in the aircraft industry and is trained extensively on the 737-200 aircraft and systems. In most instances, he speaks the language of the country to which he is assigned.

When a problem occurs, he is immediately available to provide aid. If he cannot resolve the problem himself, he contacts the Boeing plant to apply the entire resources of The Boeing Company to resolution of the problem.

Currently, Boeing field service engineers are stationed at more than 75 locations around the world. Communications with the factory are via Telex systems operating 24 hours a day.

Maintenance Technicians

Specialized Boeing maintenance personnel are available to assist the operator during introduction of new aircraft.

A team of specialized maintenance technicians is assigned by Boeing to the operator's base upon delivery of the first aircraft. This team provides on-the-job training of maintenance personnel in the areas of line maintenance and aircraft servicing.

The Boeing maintenance technicians are fully qualified on all aircraft systems and have extensive Boeing flight line experience.

The maintenance technician team is under the general direction of the field service engineer.

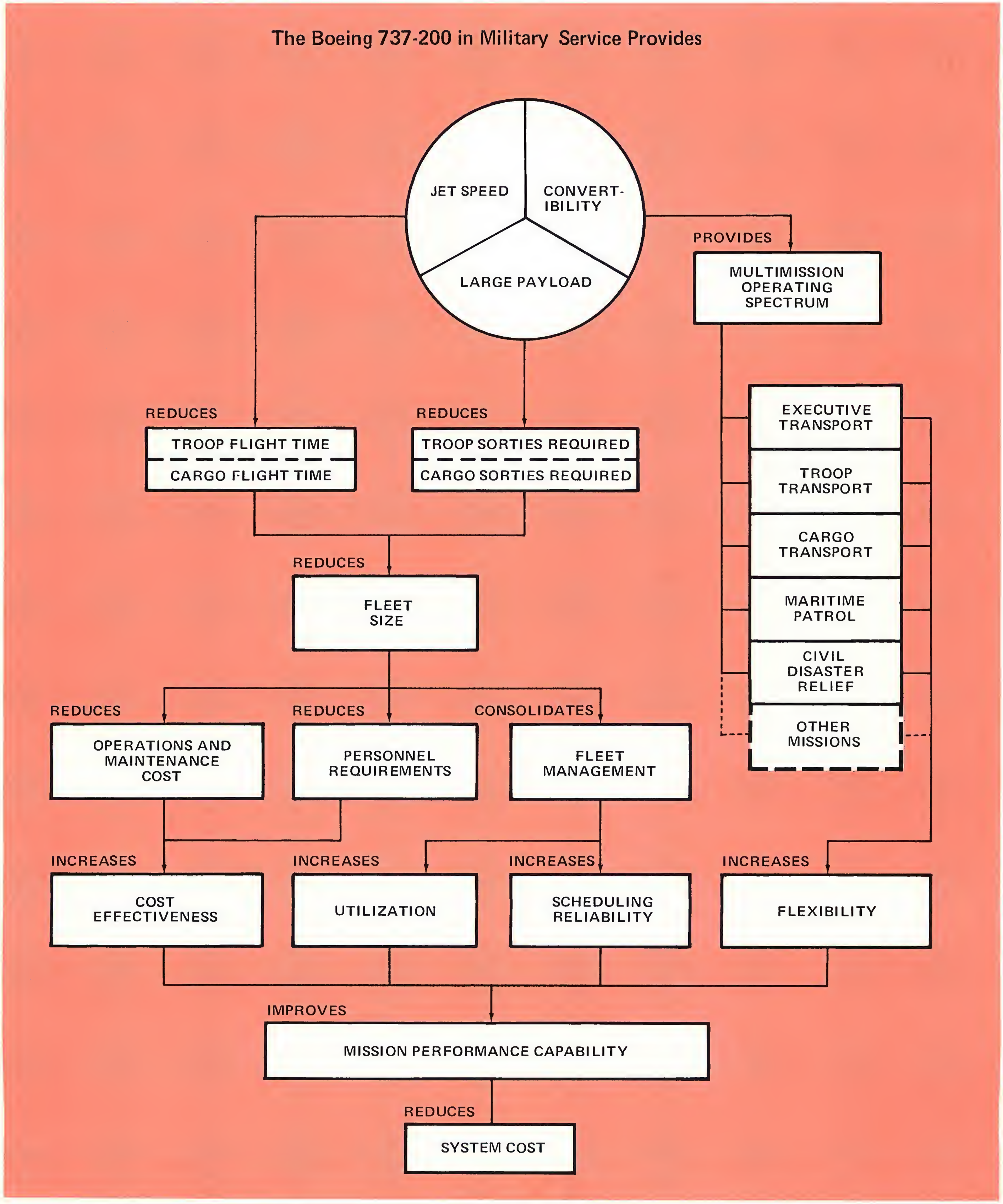
Damage Repair Teams

In the event of an accident or an incident involving aircraft damage, a team is available, at no charge to the operator, to assess the damage at the site and determine the best repair techniques. Other teams are available on a contract basis to actually accomplish the repair or provide whatever degree of assistance is desired by the operator.

Mission Analysis and Economics

Multimission Convertibility

The effectiveness of today's military forces is enhanced by multimission convertible aircraft. To achieve this effectiveness, operational characteristics of the aircraft should include ready flexibility, quick mission response, ruggedness in adverse environments, and economical operation in a wide variety of short- and medium-range missions. The Boeing 737-200 provides this multimission versatility and the productivity required—with twinjet economy.

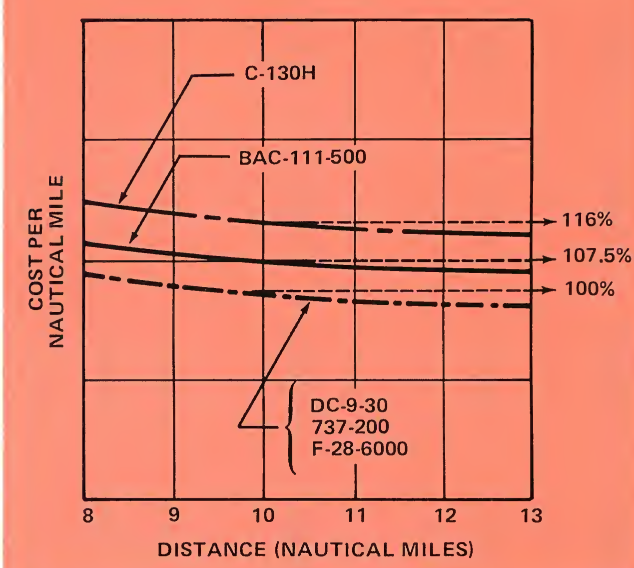


Economics

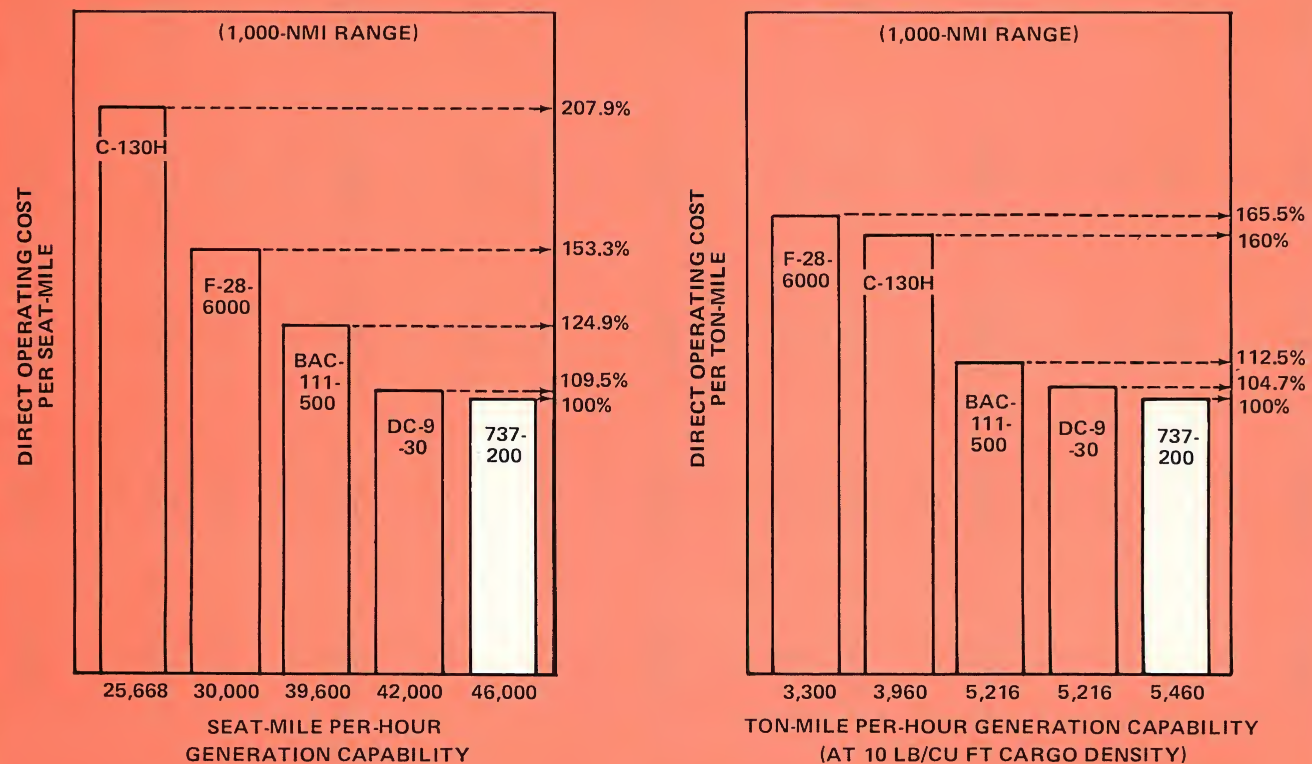
Direct operating costs, calculated using generalized assumptions and ground rules, illustrate the cost relationship between comparable aircraft. Cost estimates for specific operators and missions can be developed by defining ground rules and factors describing the requirements. These estimates can be provided as specific values in any given currency for a specified time period.

Additional economic comparisons illustrate the cost relationship between aircraft on a seat-mile and ton-mile basis. The seat-mile costs are based on the number of seats which provide an equal comfort level between aircraft (i.e. 34-inch seat pitch).

Direct Operating Cost Relationship

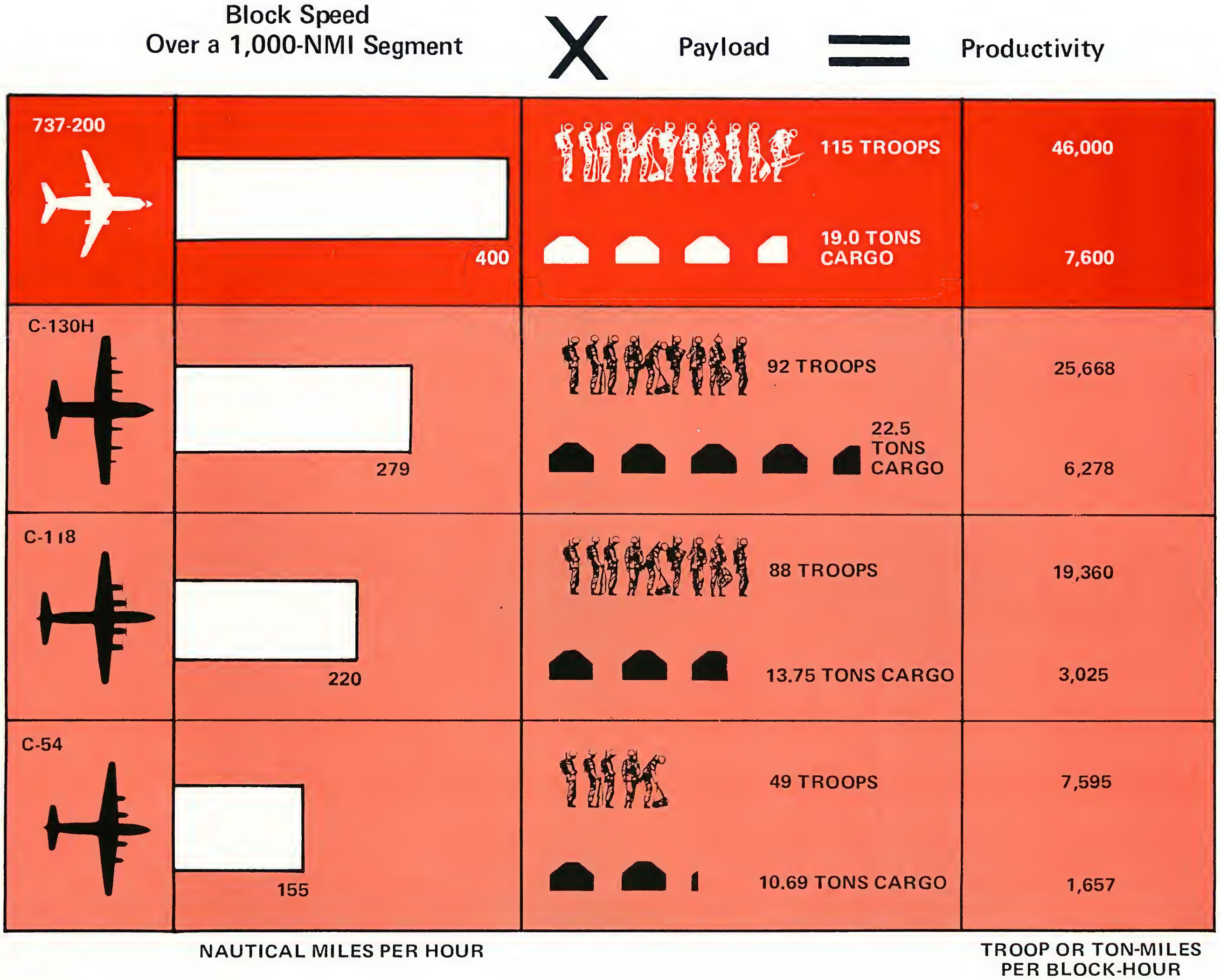


Seat-Mile and Ton-Mile Cost Comparisons



Productivity Comparisons

These charts illustrate the productivity of the modern 737-200 (high-gross-weight version) compared with older aircraft. The high productivity of the 737-200 combined with its low operating cost result in significant savings. These savings provide the basis for rapid amortization of investment cost.

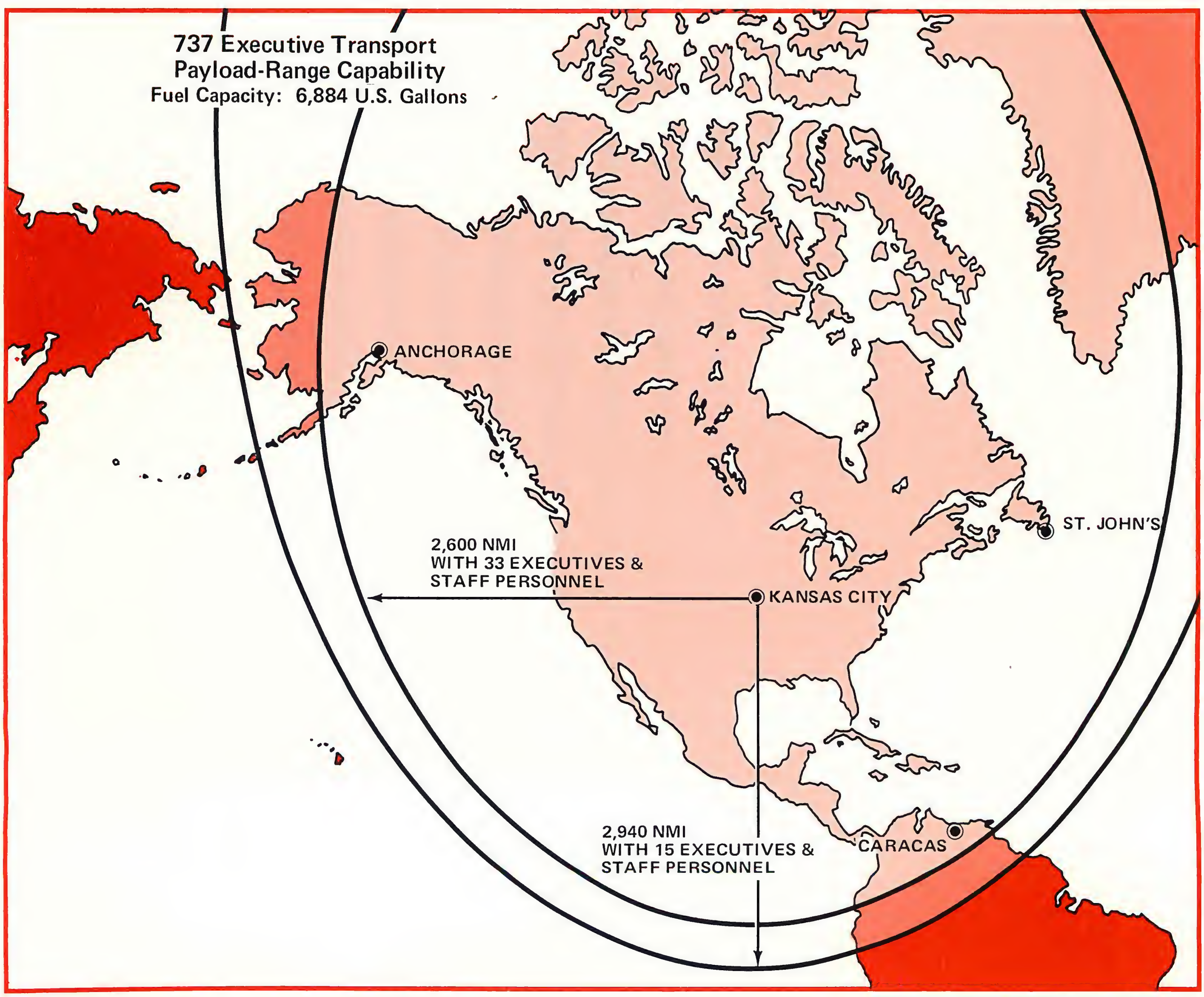


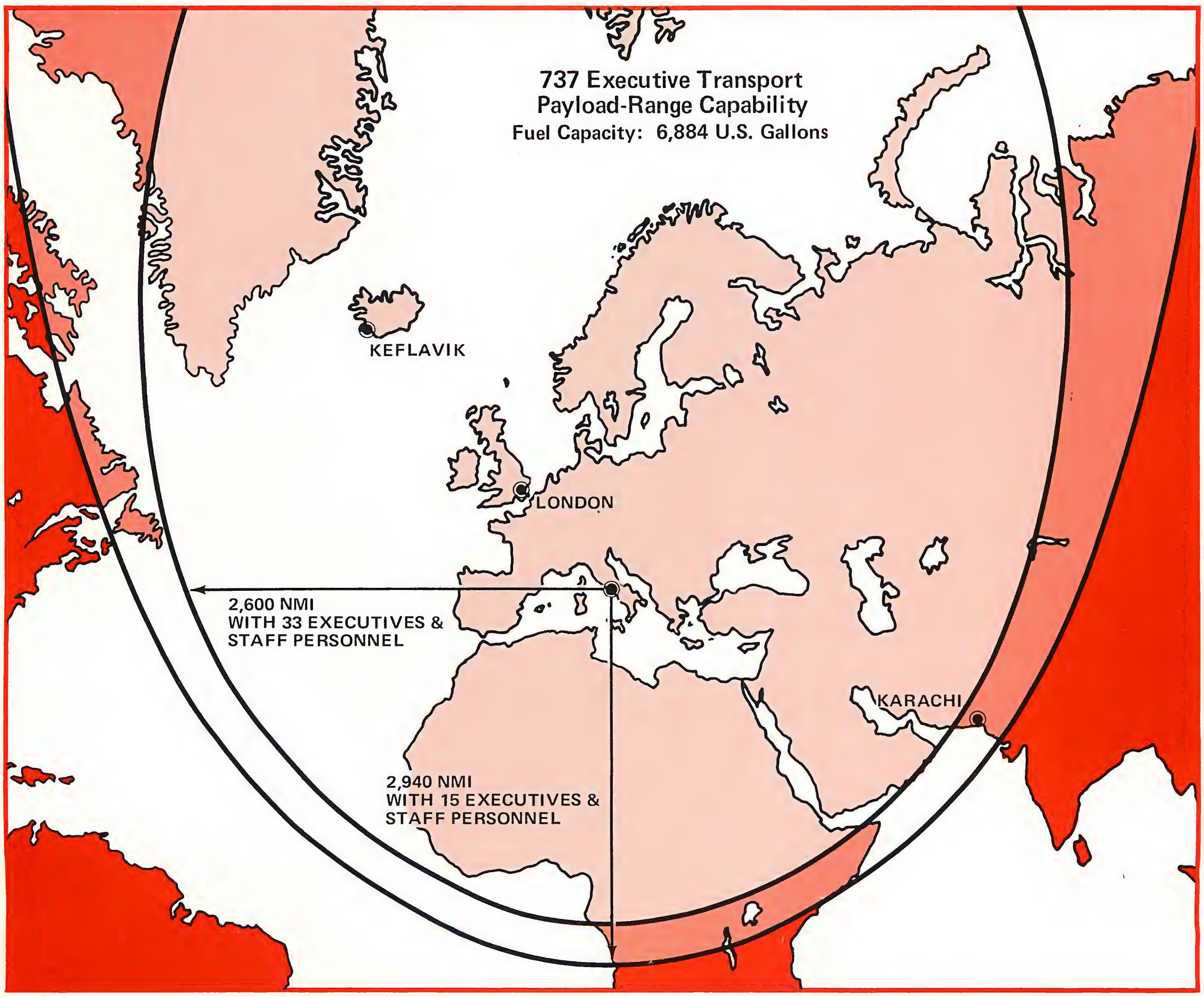
737 Executive Transport Payload-Range Capability

Range of the 737-200 in the executive transport configuration with Option 2 (6,884 U.S. gallons) fuel capacity and example executive personnel loads is illustrated by the accompanying range circles on the world map.

Using the example flight origin cities shown (Kansas City and Rome), and with typical executive loads, the 737-200 provides nonstop operation to all North and Central American destinations or to all destinations in Europe and North Africa, respectively. North Atlantic crossings are routine with one fuel stop.

These and the following range circles are constructed on a zero wind basis. The effect of en route winds will slightly increase or decrease ranges and/or payloads.

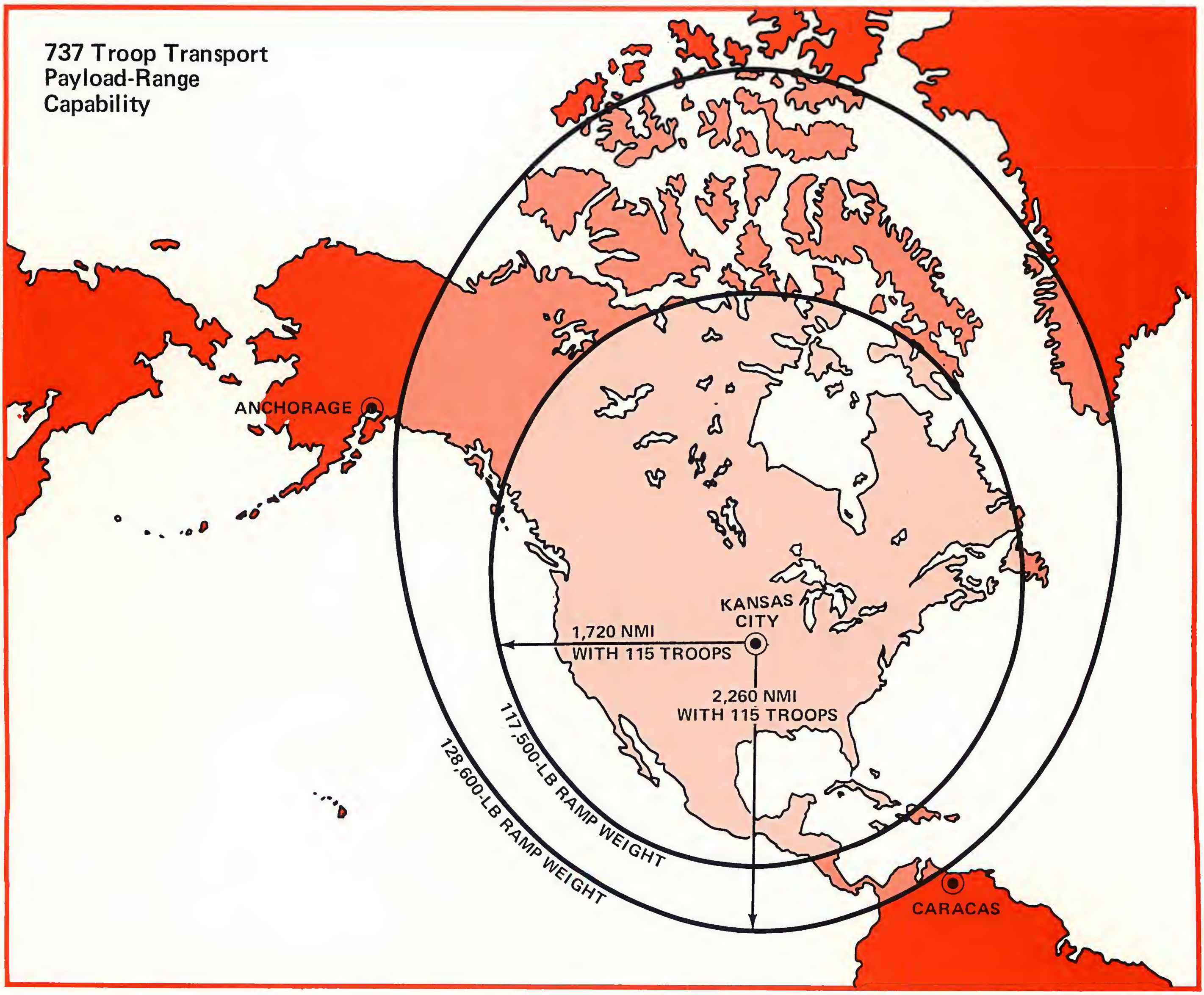


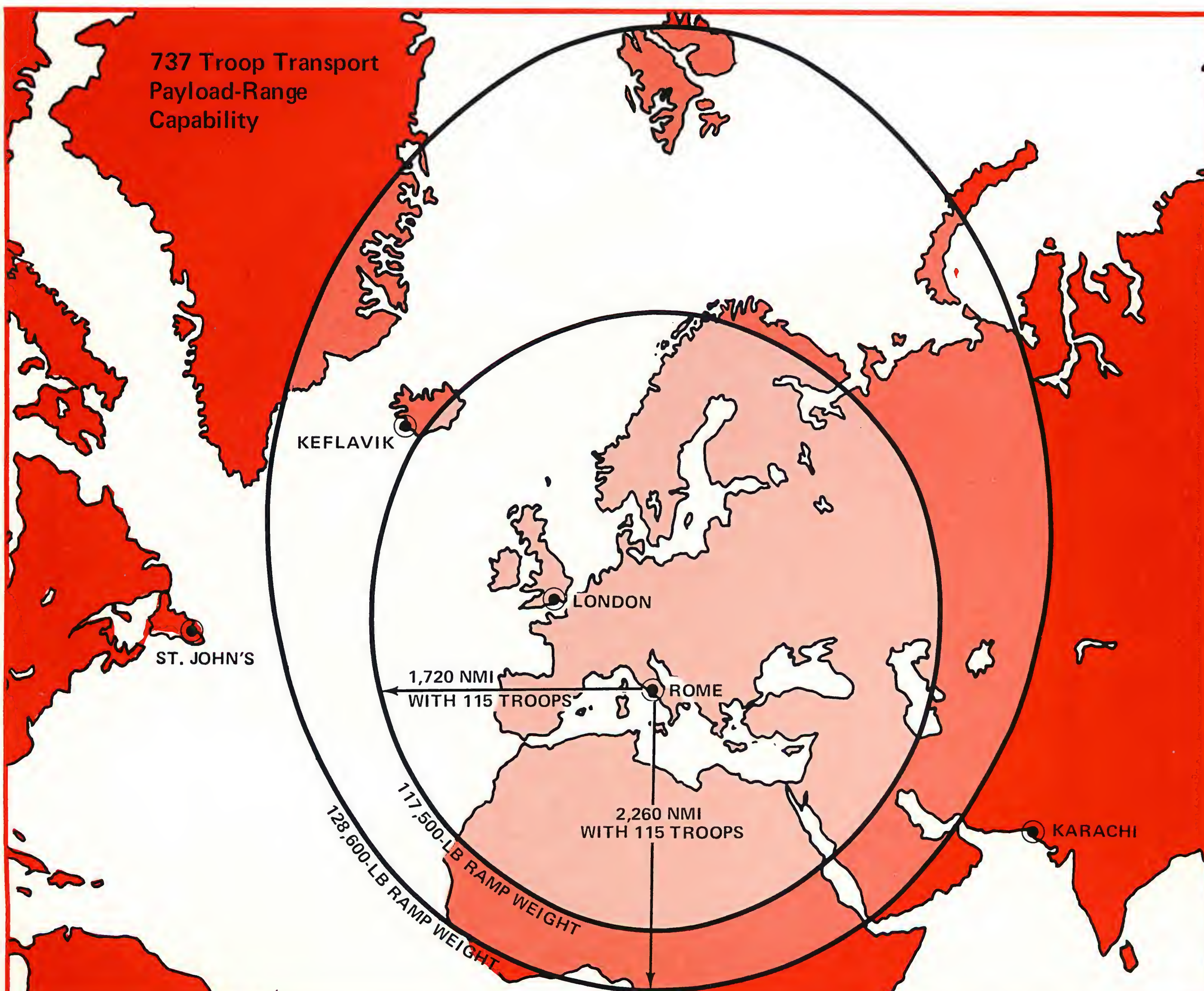


737 Executive Transport
Payload-Range Capability
Fuel Capacity: 6,884 U.S. Gallons
KEFLAVIK
LONDON
2,600 NMI
WITH 33 EXECUTIVES &
STAFF PERSONNEL
KARACHI
2,940 NMI
WITH 15 EXECUTIVES &
STAFF PERSONNEL

737 Troop Transport Payload-Range Capability

Troop transport payload and range capabilities for typical loads are illustrated similar to the executive configuration capability previously shown. Using the standard high-density troop configuration (115 troop seats), the 737 will fly nonstop from a central location to nearly all destinations on the North American continent, or throughout Western Europe and North Africa.

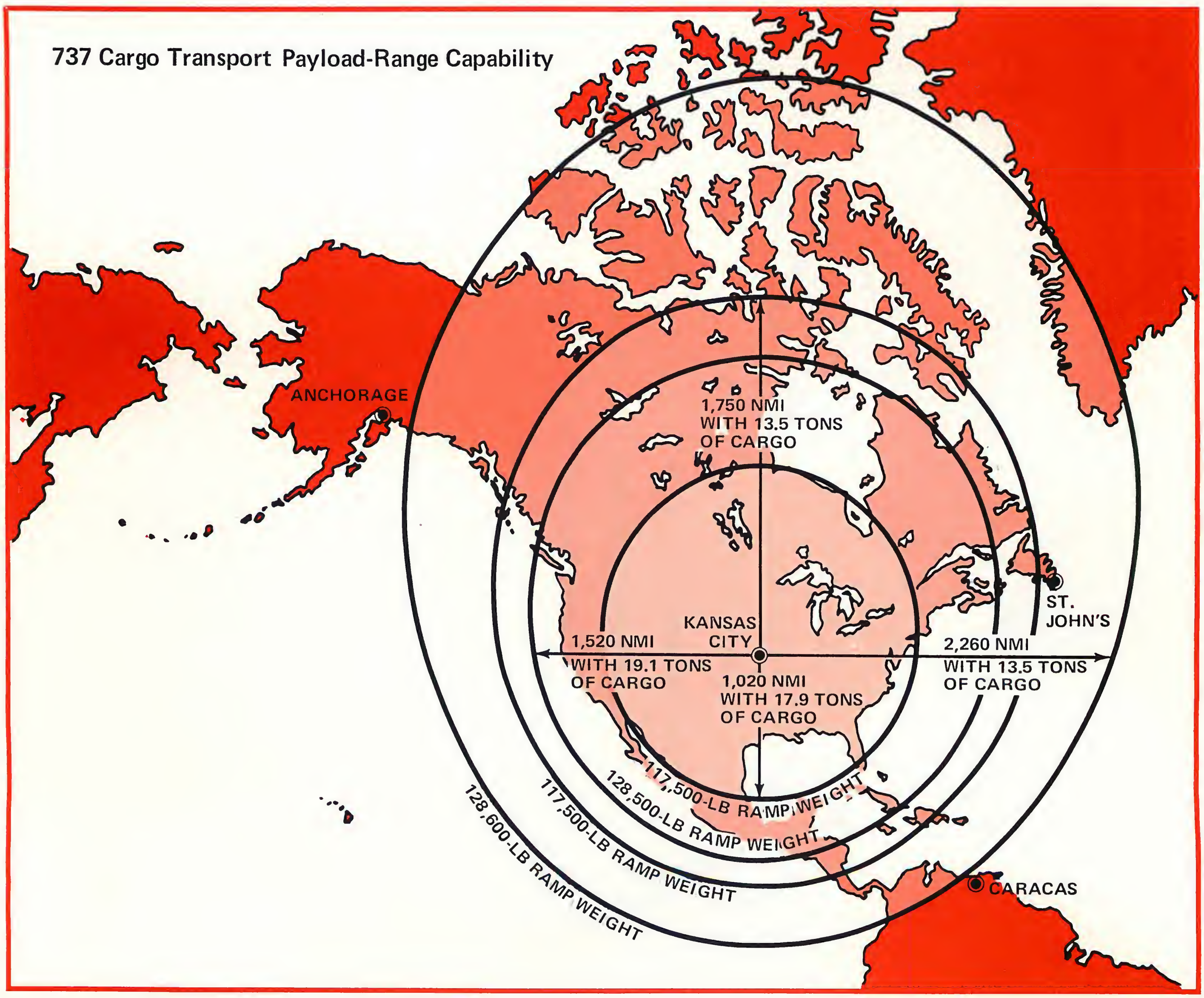


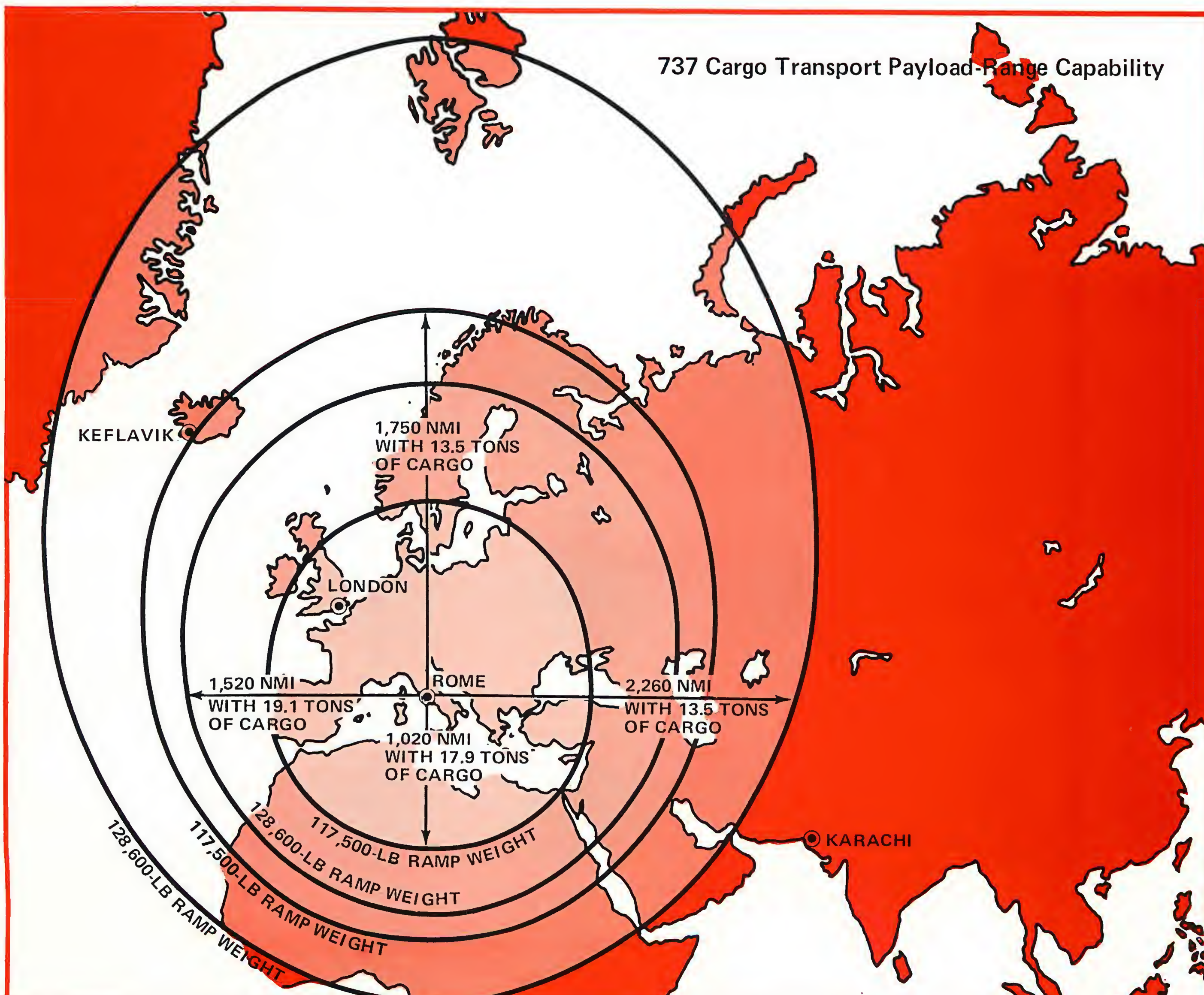


737 Troop Transport
Payload-Range
Capability
KEFLAVIK
LONDON
ST. JOHN'S
1,720 NMI
WITH 115 TROOPS
ROME
2,260 NMI
WITH 115 TROOPS
KARACHI
117,500-LB RAMP WEIGHT
128,600-LB RAMP WEIGHT

737 Cargo Transport Payload-Range Capability

Range capability with selected example cargo loads is shown. At a maximum payload of 36,000 pounds (16,329 kilograms), the 737 has a range of 1,040 nautical miles, providing nonstop cargo delivery at jet speeds to any destination within an area the size of the United States or Western Europe from a central location. One-stop transatlantic operation is possible with reduced loads.





737 Cargo Transport Payload-Range Capability
KEFLAVIK
1,750 NMI
WITH 13.5 TONS
OF CARGO
LONDON
1,520 NMI
WITH 19.1 TONS
OF CARGO
ROME
2,260 NMI
WITH 13.5 TONS
OF CARGO
1,020 NMI
WITH 17.9 TONS
OF CARGO
117,500-LB RAMP WEIGHT
128,600-LB RAMP WEIGHT
117,500-LB RAMP WEIGHT
128,600-LB RAMP WEIGHT
KARACHI

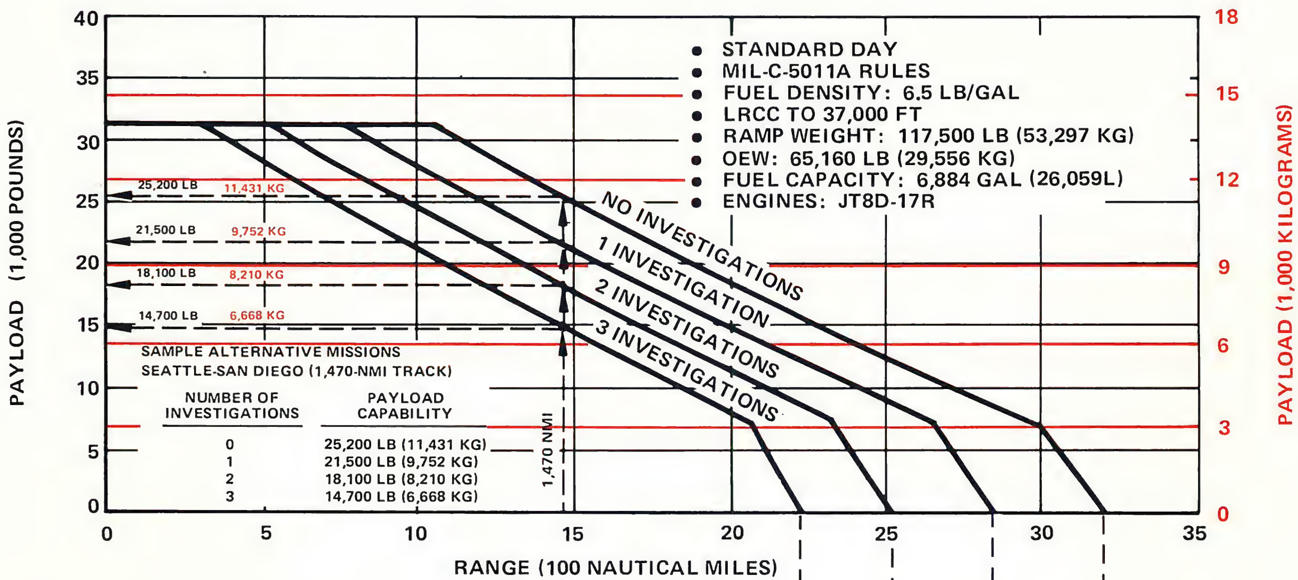
Maritime Patrol

As illustrated by the accompanying payload-range curves, the 737 maritime patrol aircraft can accomplish a 200-nautical-mile-wide coastal surveillance mission along a coastline equivalent to the West Coast of the United States nonstop while carrying a significant cargo payload.

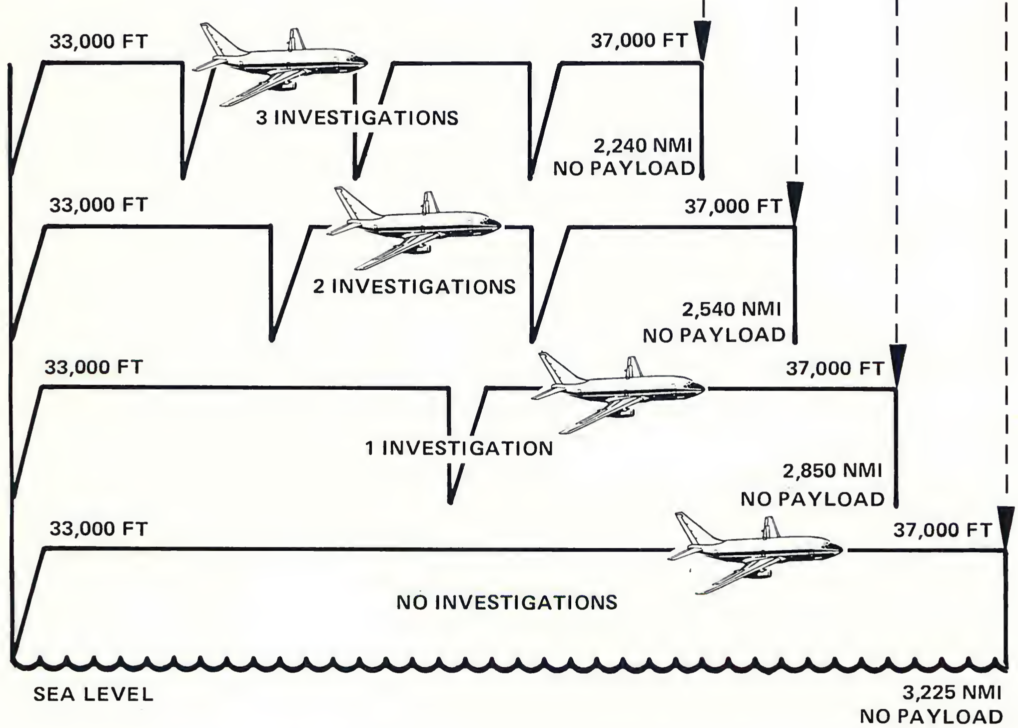
Depending upon the number of low-level contact investigations required, from 14,700 pounds (6,668 kilograms) to 25,200 pounds (11,431 kilograms) of cargo can be airlifted.

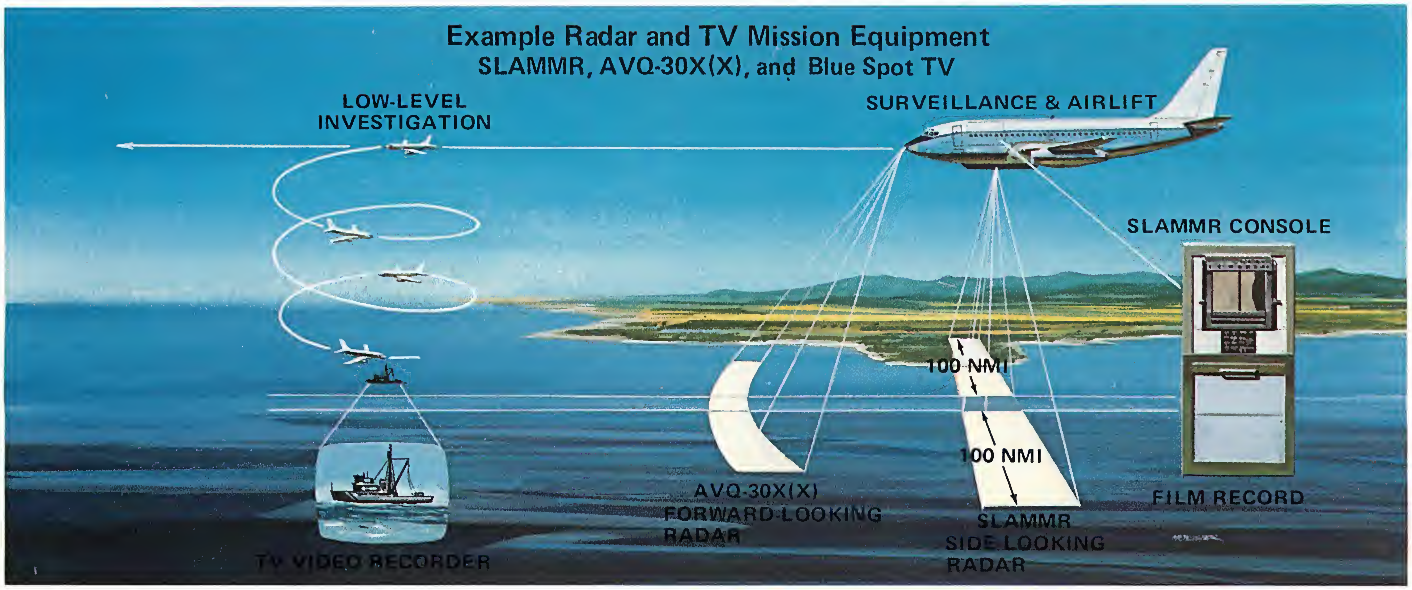
Not including the time required for contact investigations, the 1,470-nautical-mile patrol can be flown in approximately 3.7 hours, resulting in a surveillance productivity of slightly more than 80,000 square nautical miles of ocean surface area examined per flight hour.

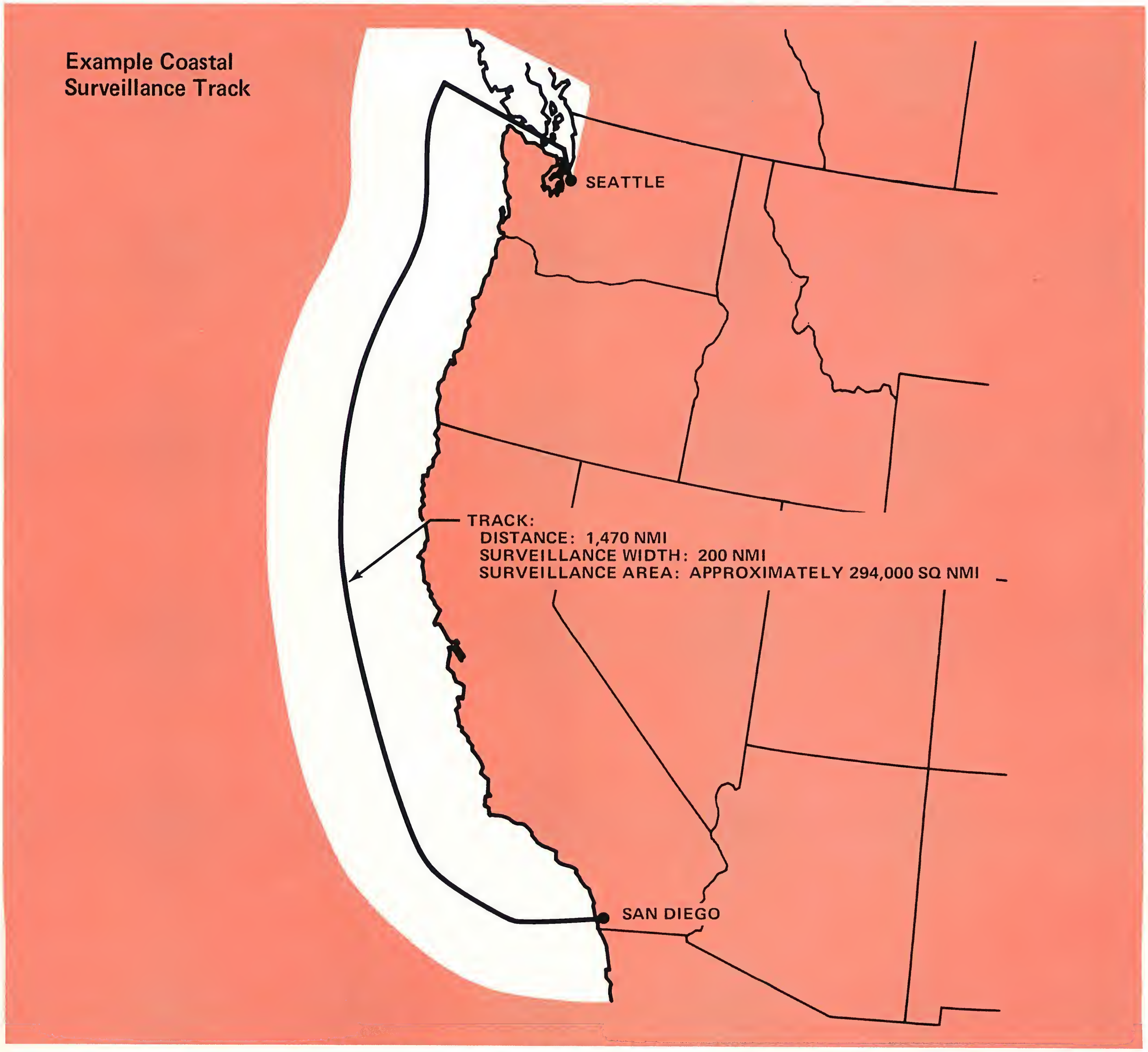
Payload Range



Mission Profiles




Example Radar and TV Mission Equipment
SLAMMR, AVQ-30X(X), and Blue Spot TV
LOW-LEVEL INVESTIGATION
SURVEILLANCE & AIRLIFT
SLAMMR CONSOLE
100 NMI
100 NMI
AVQ-30X(X) FORWARD-LOOKING RADAR
SLAMMR SIDE LOOKING RADAR
FILM RECORD
TV VIDEO RECORDER

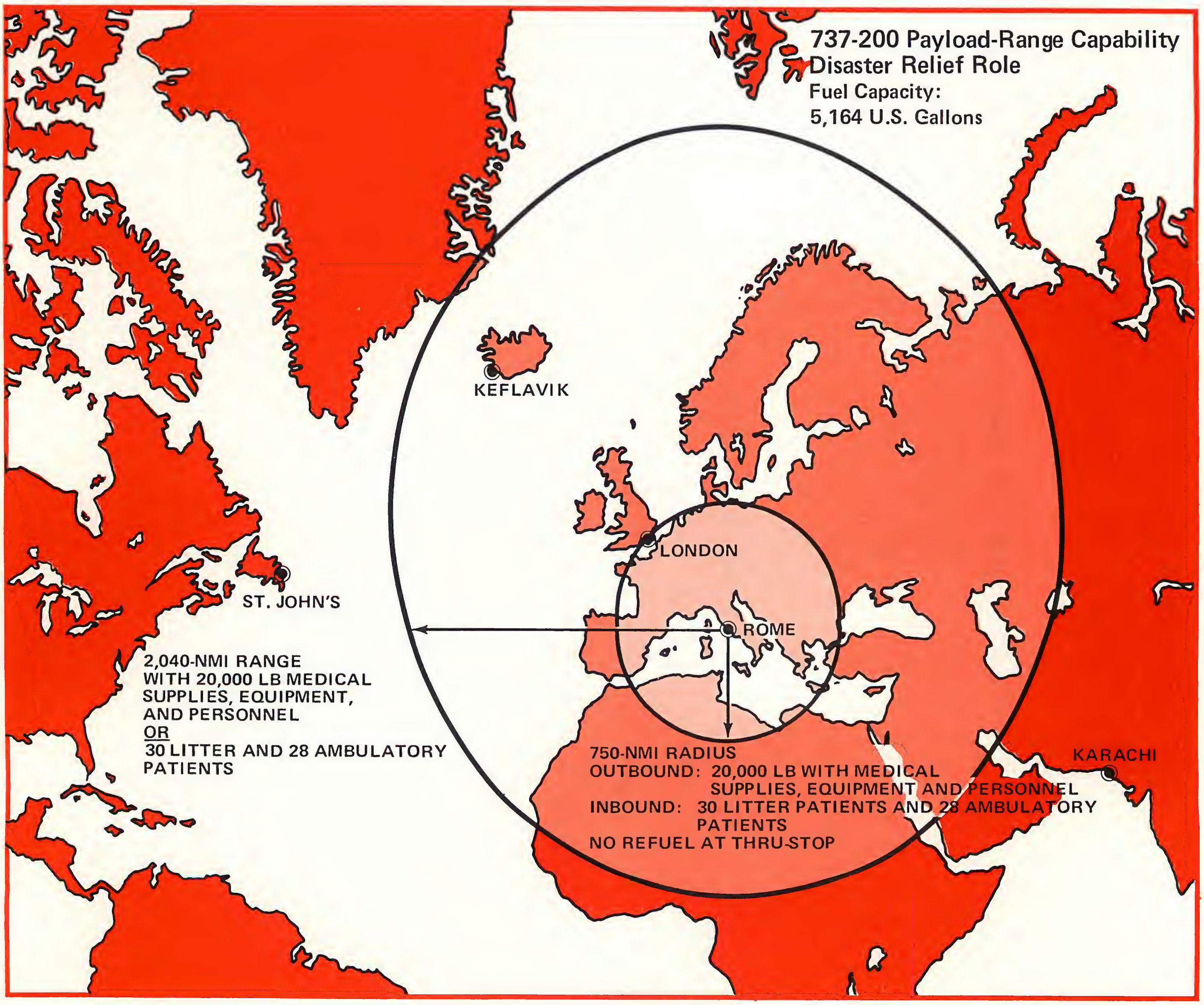

Example Coastal Surveillance Track
SEATTLE
TRACK:
DISTANCE: 1,470 NMI
SURVEILLANCE WIDTH: 200 NMI
SURVEILLANCE AREA: APPROXIMATELY 294,000 SQ NMI
SAN DIEGO

737 Disaster Relief Payload Range

Range performance of the 737-200 in the disaster relief role is illustrated for an example payload consisting of 20,000 pounds (9,072 kilograms) of supplies, equipment, and medical personnel flown to the trouble area, and a return flight carrying 36 litters and 28 ambulatory patients to hospital and relief centers.

The inner circle illustrates round trip range without refueling at the disaster area. Without refueling at the intermediate stop, the 737-200 will serve an area equivalent to the size of Western Europe and a portion of North Africa.

If refueling can be carried out at the intermediate stop, the area that can be served is illustrated by the larger range circle.



Example Air Refueling Missions

- Sweep
- Combat Air Patrol
- Strike/Deployment
- Strike

®

The following sweep, combat air patrol, and strike missions are used to illustrate increased F-16 effectiveness when employed with supporting 737 tankers. In-flight refueling significantly improves fighter range, weapon loads, and time on station, individually or in combination.

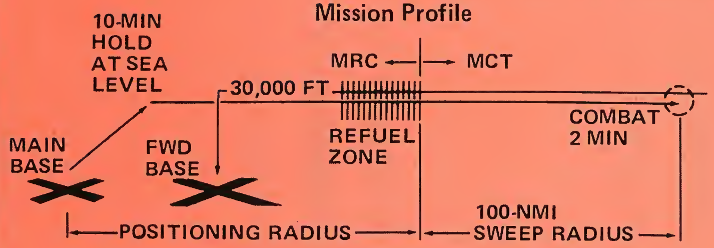
The increased F-16 capability achieved by employing 737 tanker support permits accomplishment of a given combat task with fewer resources.

Although the F-16 fighter is used in the following example missions, comparable increases in fighter force effectiveness through employment of in-flight refueling are available to fighter forces of many other types.

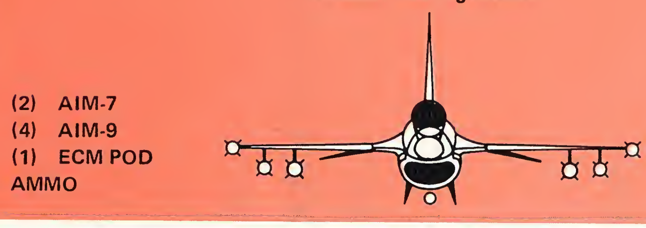
F-16 Long-Range Sweep Mission

Launch at Main Base—Fly Sweep Mission—Recover at Forward Base

Mission Profile



Mission Configuration



Mission Ground Rules

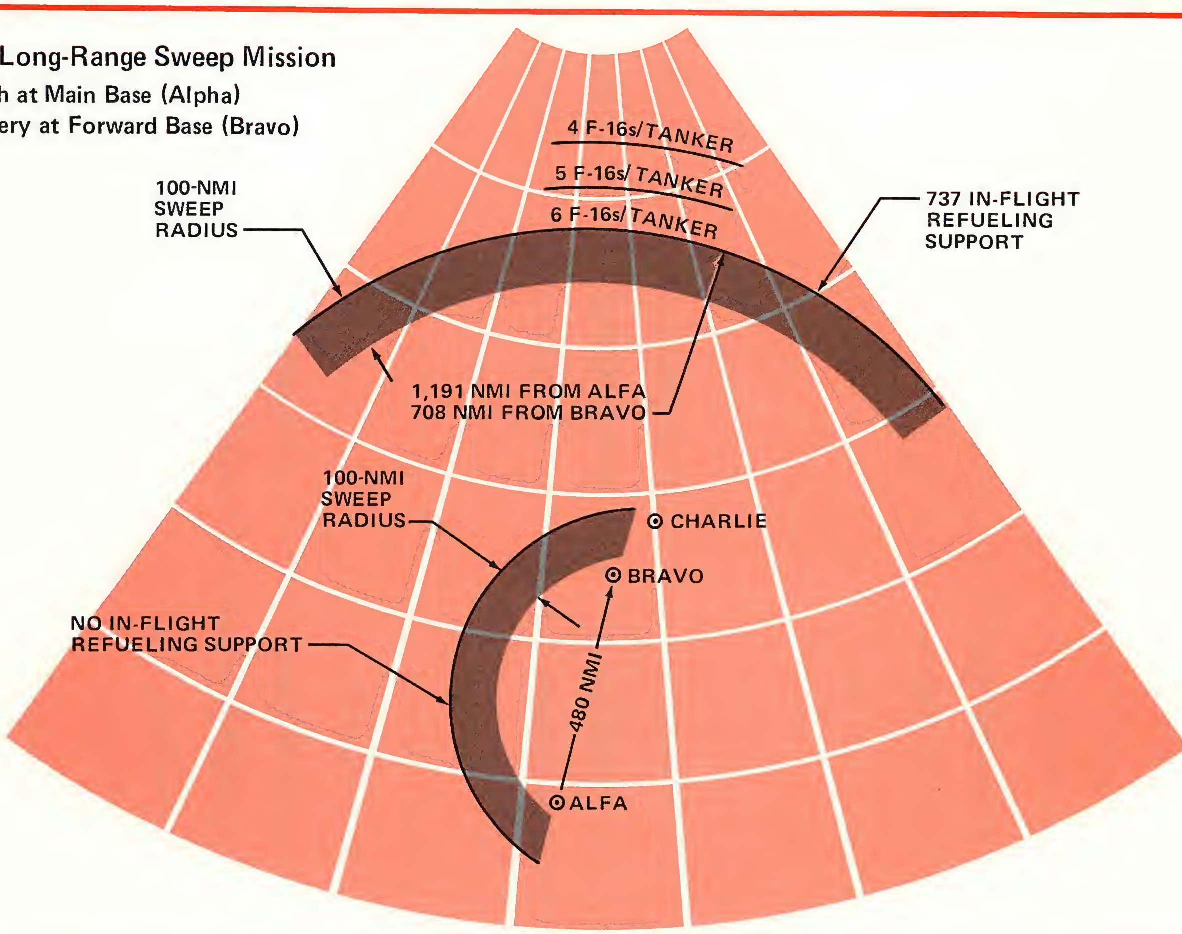
LAUNCH BASE: ALFA
RECOVERY BASE: BRAVO
COMBAT ALLOWANCE: 2 MIN
SWEEP RADIUS: 100 NMI

TANKER SUPPORT
- 737-200C MULTIPURPOSE BOOM TANKER
- RAMP WEIGHT: 130,540 LB (59,212 KG)
- OEW: 68,570 LB (31,103 KG)
- FUEL CAPACITY: 61,970 LB (28,109 KG)
- FIGHTERS PER TANKER: 4, 5, AND 6
- 7 MINUTES PER REFUEL

RESERVES
- TANKER: MIL-C-5011A BUDDY RULES
- FIGHTER: 1,100 LB (499 KG)

F-16 Long-Range Sweep Mission

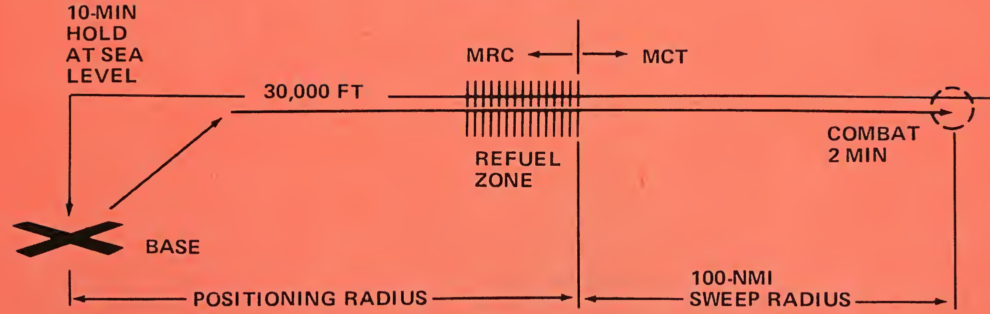
Launch at Main Base (Alpha)
Recovery at Forward Base (Bravo)



F-16 Long-Range Sweep Mission

Launch and Recovery—Same Base

Mission Profile



Mission Configuration

Mission Ground Rules

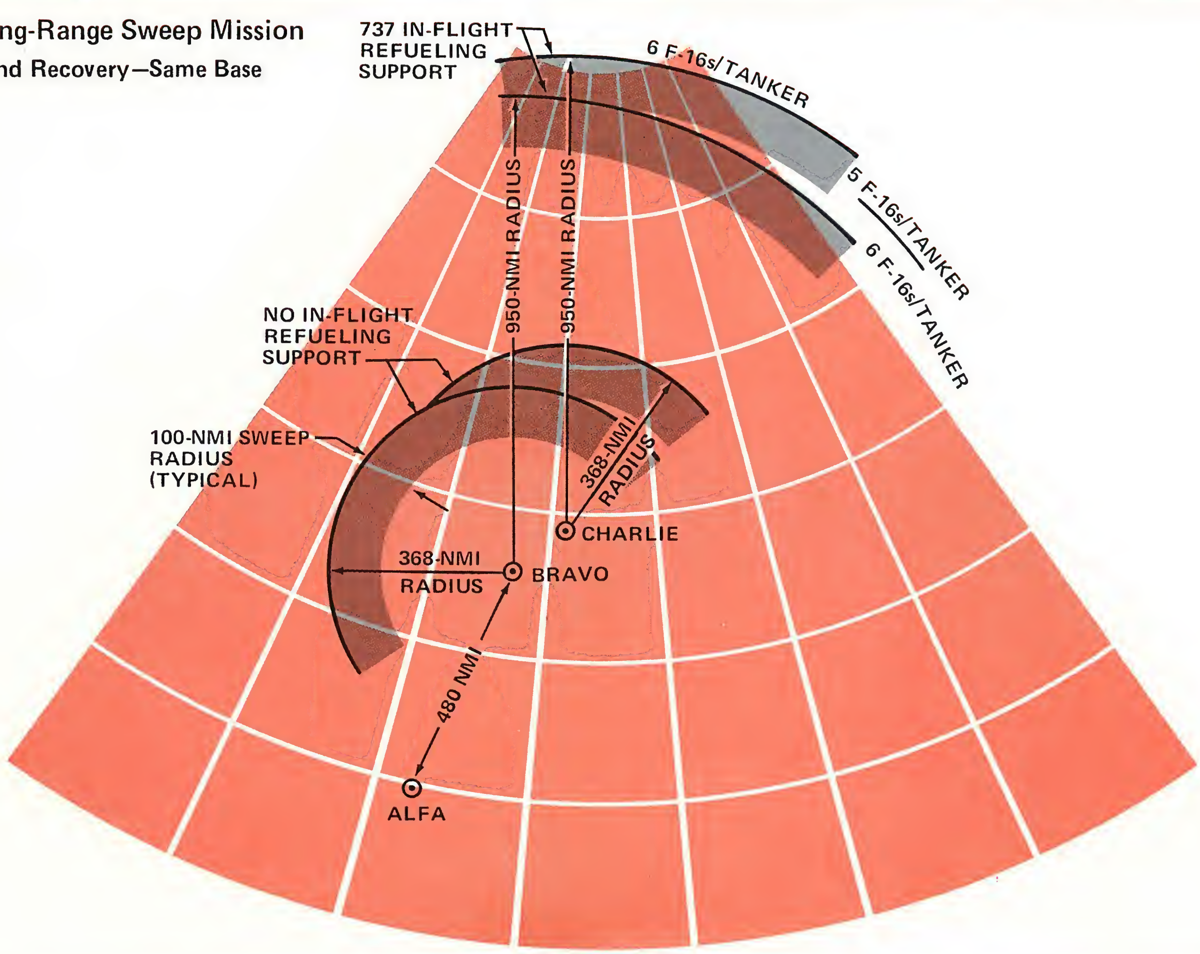
LAUNCH BASES: BRAVO AND CHARLIE
COMBAT ALLOWANCE: 2 MIN
SWEEP RADIUS: 100 NMI

TANKER SUPPORT
- 737-200C MULTIPURPOSE BOOM TANKER
- RAMP WEIGHT: 130,540 LB (59,212 KG)
- OEW: 68,570 LB (31,103 KG)
- FUEL CAPACITY: 61,970 LB (28,109 KG)
- FIGHTERS PER TANKER: 5 AND 6
- 7 MINUTES PER REFUEL

RESERVES
- TANKER: MIL-C-5011A BUDDY RULES
- FIGHTER: 1,100 LB (499 KG)

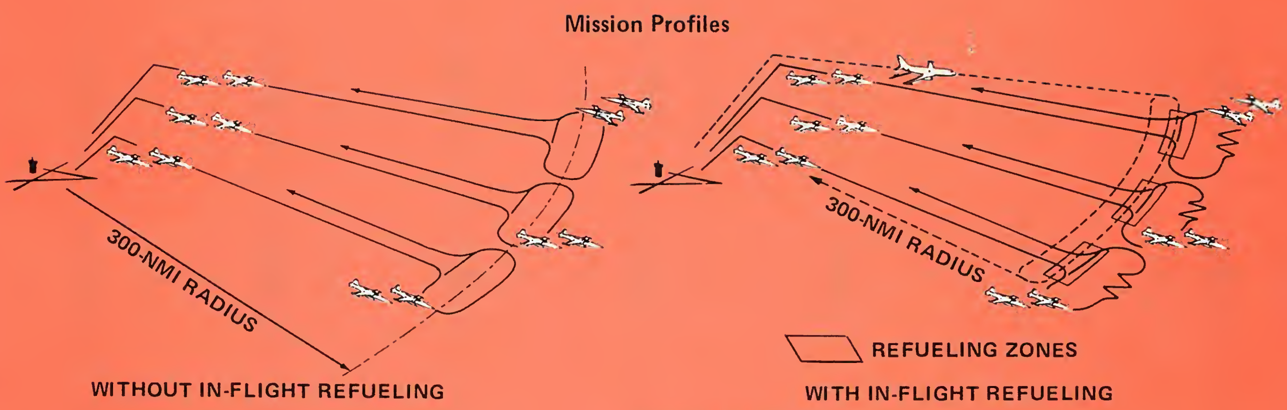
F-16 Long-Range Sweep Mission

Launch and Recovery—Same Base



F-16 Combat Air Patrol Mission

Mission Profiles



RECOVERY BASE:

Mission Configuration

(6) AIM-9
(2) 370 GAL TANKS
(1) ECM POD
AMMO

Mission Ground Rules

LAUNCH BASES: BRAVO AND CHARLIE
RECOVERY BASE: FIGHTER AND TANKER AIRCRAFT RECOVER AT BASE FROM WHICH LAUNCHED
ORBIT: 3 POINTS PER LAUNCH BASE
100 NMI APART AT 300-NMI RADIUS
2 F-16s PER ORBIT POINT

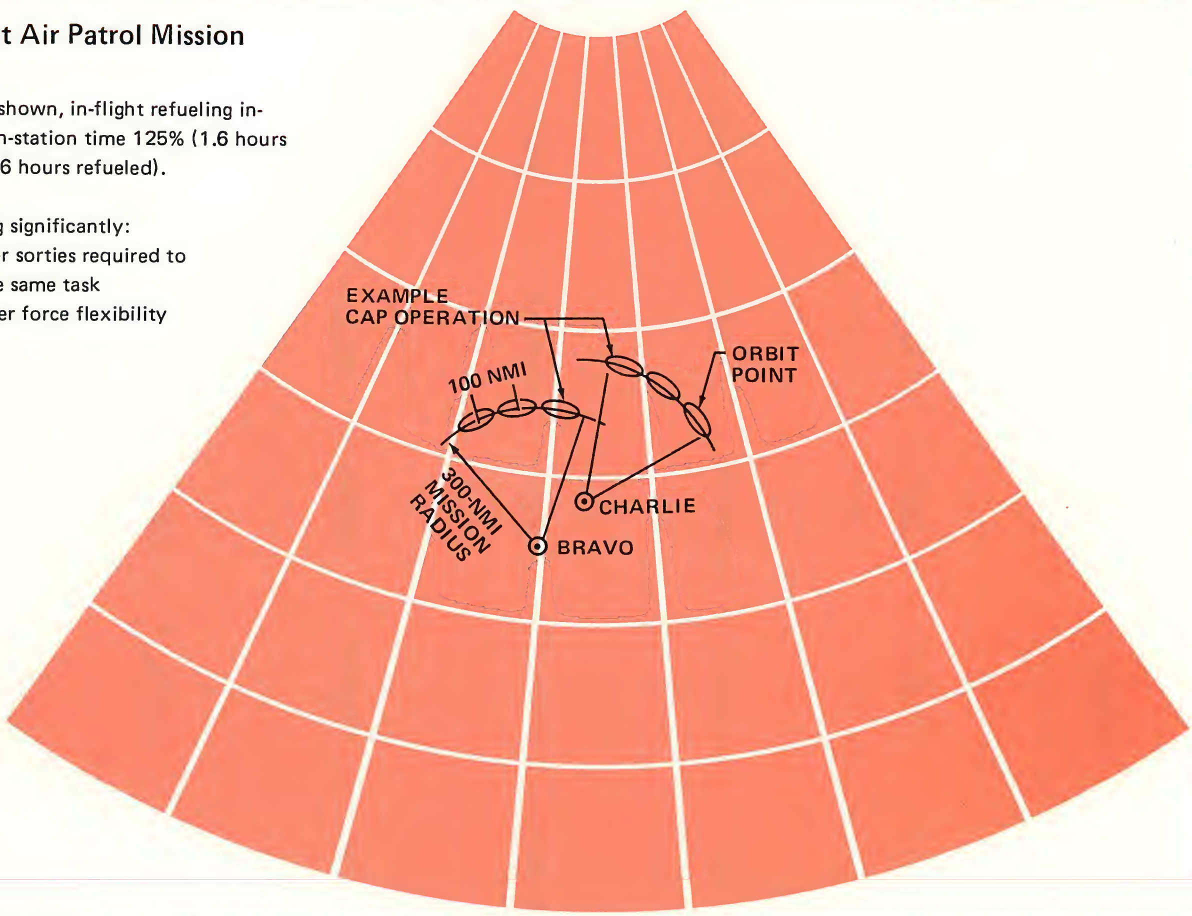
TANKER SUPPORT:
737-200C MULTIPURPOSE BOOM TANKER
RAMP WEIGHT: 130,540 LB (59,212 KG)
OEW: 68,570 LB (31,103 KG)
FUEL CAPACITY: 61,970 LB (28,109 KG)
FIGHTERS PER TANKER: 6

F-16 Combat Air Patrol Mission

For the mission shown, in-flight refueling increases fighter on-station time 125% (1.6 hours unrefueled vs. 3.6 hours refueled).

Inflight refueling significantly:

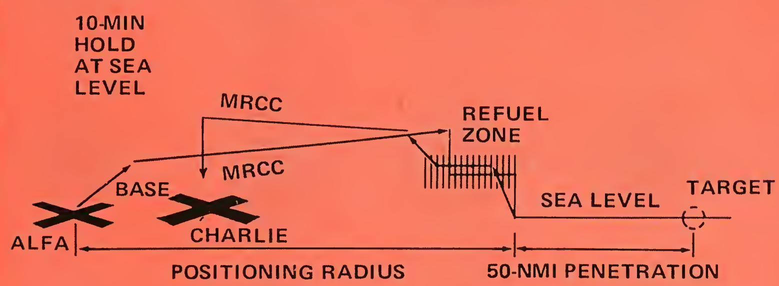
- Reduces fighter sorties required to accomplish the same task
- Increases fighter force flexibility



F-16 Strike/Deployment Mission

Launch at Main Base—Fly Strike/Deployment Mission— Recover at Forward Base

Mission Profile Hi-Lo-Lo-Hi



Mission Ground Rules

LAUNCH BASE: ALFA
RECOVERY BASES: BRAVO AND CHARLIE
PENETRATION RADIUS: 50 NMI

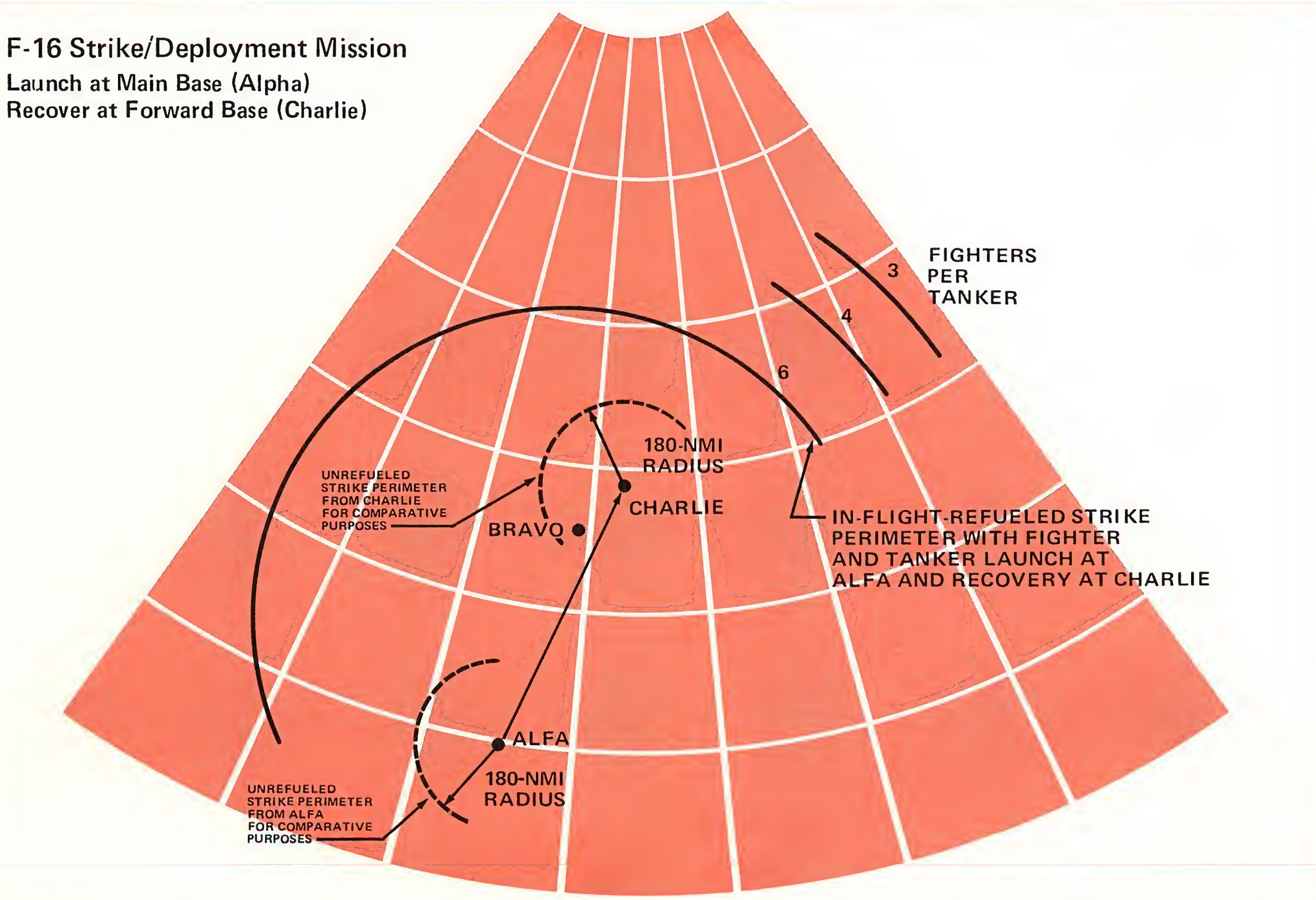
TANKER SUPPORT
- 737-200C MULTIPURPOSE BOOM TANKER
- RAMP WEIGHT: 130,540 LB (59,212 KG)
- OEW: 68,570 LB (31,103 KG)
- FUEL CAPACITY: 61,970 LB (28,109 KG)
- FIGHTERS PER TANKER: 3, 4, AND 6
- 7 MINUTES PER REFUEL

RESERVES
- TANKER: MIL-C-5011A BUDDY RULES
- FIGHTER: 1,100 LB (499 KG)

Mission Configuration

F-16 Strike/Deployment Mission

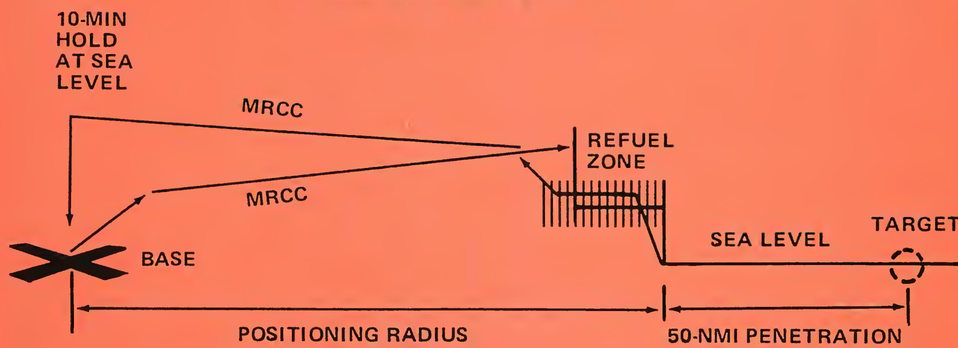
Launch at Main Base (Alpha)
Recover at Forward Base (Charlie)



F-16 Strike Mission

Launch and Recovery—Same Base

Mission Profile Hi-Lo-Lo-Hi



Mission Configuration

Mission Ground Rules

LAUNCH BASES: BRAVO AND CHARLIE
PENETRATION RADIUS: 50 NMI

TANKER SUPPORT
- 737-200C MULTIPURPOSE BOOM TANKER
- RAMP WEIGHT: 130,540 LB (59,212 KG)

OEW: 68,570 LB (31,103 KG)
- FUEL CAPACITY: 61,970 LB (28,109 KG)
- FIGHTERS PER TANKER: 3, 4, 5, AND 6
- 7 MINUTES PER REFUEL

RESERVES
- TANKER: MIL-C-5011A BUDDY RULES
- FIGHTER: 1,100 LB (499 KG)

F-16 Strike Mission

Launch and Recovery—Same Base